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## TRAIN TELEPHONY AND TELEGRAPHY.

A good deal of talk has been heard lately as to the general adoption of the telephone in place of the telegraph on steam railroads. Without doubt, the telephone is finding a place in railway work, and theoretically it has several recommendations. The difficulties and objections are often overlooked, however, and we give in this issue an expert's discussion of these practical points. It will be seen that the limitations are quite serious. But within them we look for a rapid extension of use, and shall be prepared to find the telephone widely adopted as an important auxiliary, even if it should not usurp all the time-honored functions of the telegraph.

## STREET DESTRUCTION.

For some time past New York has been torn up, and her streets bid fair to remain in a state of disruption for many months to come. It has seemed as though, in this respect, New York would be hard to beat, but the reports now coming from London show that the state of affairs there is worse, being intensified by all the conditions of fog, gloom, dirt and slush that are the natural concomitants of the English winter. But our English friends, in their usual solid manner, are looking into the question to see whether for its main thoroughfares London cannot have a subway system for wires and cables, pipes, etc., so that the surface of the street would never have to be disturbed. The figures quoted in an item in this issue prove that not only have the electrical companies, gas companies, etc., torn up the streets with amazing and exasperating frequency, but that they have spent millions of pounds in doing so. The same is true of New York, where the automobile is being subjected to the rudest tests, owing to the manner in which so many of the asphalted streets are ripped to pieces. This form of waste and this absence of good engineering, is one of the evils to which the new century can well address itself. There can be no good roads until they are permanently laid.

## THE BENEFITS OF ELECTRICITY.

The readiness of many people to deny that electricity has conferred any benefits on mankind is quite striking. It is particularly noticeable at such a period as this when humanity makes up its accounts and strikes a centennial balance sheet. Some persons insist that certain items are on the wrong side of the ledger; others, that the items have a wrong value attached to them. Thus Emile Zola has celebrated the end of the century by inquiring despairingly what the telegraph, telephone and electric light have done to fill the stomachs of mankind; the inference being, of course, that they have done nothing, regardless of the point whether that is their mission or not. We had been under the impression that the telegraph and telephone had done much to equalize and distribute the supply of food all over the world, but Zola has probably had his thoughts so intent on other questions connected with fecundity that he overlooked the fact that telegraphy is to-day one of the greatest known safeguards against famine.

And now comes Richard Le Galliene, so well known for his economical writings on the golden-haired girl. He gets this off: "We all know that the idea in the minds of the dreamers of machinery was the lightening of human labor, just as a man buys a motor car to save him walking. That expectation, however, we all know too well has not been fulfilled. A few favored ones are carried in the motor car, but for the most part the motor car is carried on

the shoulders of a straining, sweating humanity." He goes on to develop this naturally into the remark that machinery has not been a liberator but "the most terrible engine of enslavement the world has seen," the reason being that "a few rich men have bought up all the machines." Such cases as this seem hopeless. One may permit a poet to exercise the license of his imagination, but when he froths like this, one can only regret that the man was not born in antecedent ages when all were free and did not have a single improvement to worry them, not even clothes.

### THE MANHATTAN RAILWAY.

In this issue is concluded a description of the general details of the electrical equipment of the Manhattan Elevated Railway of New York City, now being installed. Even those who follow currently the development of electric traction cannot but be impressed with the magnitude of the system now being put down for the elevated roads. Indeed, fifteen years ago one would have been considered daft had he predicted the installation of an electric traction system by the close of the century calling for generators towering 42 ft. into the air and weighing 445 tons, and supplying a service demanding current for motors aggregating, during the period of heavy load, 70,000 amperes at 625 volts. The immensity of such systems as those of the Metropolitan and Manhattan railways naturally involved many problems, but so comparatively simple is it to pass from small to large types of electrical generating and receiving apparatus that the principal problems have not related to these, but notably to such details as the switching arrangements. As described in outline, it will be seen that the arrangement that will be used on the Manhattan road safeguards in a remarkable degree against interruptions of the service from accidents to any part of the system. To attain this end necessarily involved considerable complication, but this has been happily balanced by an admirable controlling system operated from boards containing in miniature a general scheme of circuits which can be taken in at a glance, and where, for instance, the throwing of a small knife switch on a dummy circuit operates a monster oil switch on a working circuit.

### THE EVOLUTION OF THE ELECTRIC RAILWAY.

Elsewhere in this issue appears the concluding article of our series "Electricity in Two Centuries," the branch of electrical application treated being the electric railway. The writers of the article come to the subject with minds free of the natural bias of those in close contact with the every-day details of the art, which is apt to prevent them from taking radical views as to the future of the art. Thus unfettered and with ample qualifications to view the subject from the standpoint of broad electrical principles, the speculations contained in the article will bear careful thinking about. They must appear a bit radical at first sight, but the radical to-day is the conservative of to-morrow, so that one can well afford to have patience. Their favorable horoscope for conduit roads will surely not surprise us if it comes to its fullest accomplishment. Steadily decried until engineers were permitted to put the necessary expense into its construction, its record in New York City gives ample promise of a very striking future. Nor is it saying too much to assert that our authors' judgment of the direct-current motor system as applied to trunk lines is thoroughly sound, for in such work polyphase traction is surely at its best with everything in its favor. And the suggestion of varying the periodicity at the station to make up lost time strikes us as being most useful and practical. In point of fact, such a process could be very simply carried out in practice. For on a high-speed trunk line of such length as would be desirable for the great speeds that are surely to come, the whole line would not be operated from a single station, but in sections, perhaps a hundred miles or so in length. This would mean that few trains would be on any one section at the same time. Now, when equipped with induction motors, a locomotive could run fairly well at a considerable range of speeds below synchronism, even if occasional coasting were necessary to do so economically. But they could not run at or above synchronous speed, and so could not make up time. If, through delays, such a step became necessary, it would only be needful to wire the power station to raise the frequency 10 per cent or so, and the train affected could then make haste, while the one or two other trains on the same section could run on slightly increased slip or by occasional coasting during the process.

But to the conclusions we must take exception vigorously in one respect. We have never been able to see what conceivable excuse for material existence is to be assigned to that composite oddity, the Heilmann locomotive. In our early youth some aggressive and doubtless well-minded temperance society scattered broadcast a fearfully and wonderfully colored lithograph entitled "The Black Valley Railroad." We can see it as if it were but yesterday, a long, sinuous line, running from the fair fields of grace in the upper left-hand corner down through Tippletown and Sotville, by Drunkard's Gulch and Devil's Home, to the ulterior suburbs of Sheol in the lower right-hand corner. It had trains as many as the heart of manager could wish, all fitted up with café cars, faro cars and pool-for-drinks cars, and none ever ran back, which must have called for an unconscionable amount of costly rolling stock. And around about the picture ran an alluring fringe of drunkards' stomachs in progressive stages of dilapidation. But its chief glory was in the locomotives—long-wheeled dragons, with firemen amply horned and tailed. And since those days of childhood we have never seen a locomotive so soul satisfying save the Heilmann. A whole power station per train to save the shock of reciprocating parts seems needless at best, and when one considers the necessary loss of energy incurred in so operating, the wonder is not that it has failed of extensive use, but that any human being should ever have thought of such a contraption. And in the present state of affairs, if one really means to try for transcendental speeds, what is the matter with the steam turbine? We are far from crying down our own wares, but an eight-wheeled locomotive with a 400 or 500-hp steam turbine on each axle would make speed at a rate that would make even an electric motor bend to its work to keep within sight. Moreover, there is good reason to think that the turbines would not only beat the present locomotive considerably in point of efficiency, but in the matter of cost of operation would push electrically transmitted power quite as hard as would be comfortable. Engineers who are familiar with the modern developments of steam turbines would do well to sit down and think this matter solemnly over.

But there are many other suggestions in this paper worth thinking about. Although the world's supply of coal is far from being seriously depleted as yet, every decade will see further inroads and the coal supply less convenient in distance and less satisfactory in average quality. It certainly behooves mankind to utilize natural sources of energy so far as may be, and this tendency to help the transmission of power for railway and for other purposes. Coal once burned is lost for all time, but the water that has done its work comes back again in due season for another period of helpfulness. And the world's water powers are hardly touched as yet, so that as time goes on and the coal problem looms up, there is much that can be done to conserve the supply. Electricity direct from coal, if we are lucky enough to get it, will work wonders, for even doubling the efficiency of the transformation of the energy of carbon into work means putting off the evil day for many centuries; and there is still another possibility that must not be forgotten—the direct transformation of solar radiation into electrical energy. The problem has not as yet been touched, but it certainly is as far within the range of possibility as electricity direct from coal, and infinitely more important in its

possible results. For the coal supply is not renewed, and sooner or later the time must come when its end will be in sight, but for the other—it could be relied upon until the sun grew cold and the children of men and their need had passed away.

### KEW MAGNETIC OBSERVATORY AND THE DEADLY TROLLEY.

We are so accustomed to hear the welkin of the daily press ring with the horrors of the trolley, that we are growing somewhat callous to the outcry of Cassandra. At first no doubt many persons were killed by electric cars, owing to the increase in the speed of traction which electricity provided, and there is no doubt that carelessness on the part of drivers may be the cause of wanton destruction. The diminution in the number of fatal accidents due to being run over by trolley cars is diminished, partly by increased experience and training on the part of motormen, and partly by the education and experience of the people, who, down to the youngest children, have learned the habit of watchfulness for electric cars. The wail this time comes from over the Atlantic, and it is not the citizens, but an observatory that is assailed. The electric railroad takes powerful currents, and when these return via the track, particularly when they partly return via the ground, they exercise a magnetic influence at comparatively long range—a range as long as or longer than that of the most powerful cannon, when delicate magnetic measuring instruments are in question.

The electric traction companies engaged in exploiting the neighborhood of Kew in the outskirts of London are temporarily blocked by the powers in control of the Kew observatory, who fear the disturbing influence of the electric working currents upon the magnetic recording instruments. A continuous record of the local magnetic elements has long been established in this observatory, and an effort is being made to protect the ether in the vicinity of the observatory from violence at the hands of the ruthless motorman. The powers that be, want the traction company to operate the double-trolley system, and when the company demurs, insist upon the maintenance of a difference of potential between the tracks and ground, which is said to be unreasonable and impossible.

It is difficult to judge impartially of events occurring nearly a quarter way round the globe, but the case seems a simple one. If the electric traction companies could at small extra cost completely protect the observatory, it would be reasonable to demand the additional expense. We doubt, however, whether the particular neighborhood of Kew can be magnetically shielded for many decades, in view of the increase of electric systems. If the cost of protecting the observatory were prohibitively great, then Carthage must be destroyed, and the observatory should go. As to where it should go is a question to be answered by those in authority after consulting the map of the British Islands, and the local probability of freedom from electric car systems. There is no doubt whatever as to the value to science of a proper magnetic record, and there is no doubt of the desirability of maintaining that record unbroken. But when the choice comes between providing a community with cheap, rapid transit, and maintaining a temple of science, we think that the question admits of but one answer. After all, it is not so expensive to build a new house in which self-registering magnetometers can be watched and safeguarded in a remote and inaccessible district, far from the madding crowd. We certainly want all the knowledge about the earth's magnetism that we can afford to accumulate, and that people can afford it most which experiences the benefits of cheap and rapid traction.

### PERSISTENCE OF VISION.

An interesting research upon the borderland of psychology and of photometry is published in the last number (November-December, 1900) of the *Physical Review*. An acetylene flame burning under uniform pressure sent a beam of light through a spectroscope, and the beam was periodically interrupted by a slit disk, with quadrantal sectors, rotating at a controlled and determined speed. The disk speed at which the interrupted beam appeared continuous to the eye, in any particular part of the spectrum, measured the persistence of the vision of the observer for that color under those conditions. Such a series of observations are necessarily local and specific, since the persistence depends upon the intensity of the light, and the results are, therefore, dependent upon the particular spectrum furnished and its intensity at each point. Within this limitation, however, a number of interesting observations are recorded. The persistence observed varied between one-hundredth of a second in the yellow, and one-thirtieth of a second in the violet.

The persistence was found to be increased throughout the spectrum when the eye was rested in total darkness. If we assume that the mechanism of the eye corresponds to that of the coherer and decoherer, then it is easily understood that the sensibility of the coherer may increase with rest in darkness. Consequently, we might expect the stimulus of vision upon the rested eye to be so much increased that the decoherer's action would be delayed and the persistence of vision thereby increased. The curious effect supervened, however, that when the eye was purposely fatigued by exposure for several minutes to a powerful beam of simple primitive color (red, green or violet) the persistence of vision was increased in that color, although it was not sensibly altered in other parts of the spectrum. At first sight this appears to be in opposition to increase of persistence with rest. One would at first thought assume that if rest increased persistence, fatigue should decrease it. The observations, assumed as correct, can, however, be accounted for by supposing that the fatigue affects the decoherer more than it affects the coherer, and consequently, although the coherer stimulus may be weakened, and a constant decohering action would extinguish it more quickly, yet the decoherer is still more exhausted, and the vision persists longer by reason of delayed decohering. The increase of persistence accompanying fatigue varied from 8 per cent in the red to 27 per cent in the violet, and was, therefore, quite an appreciable quantity. A very interesting observation was also made in one or two cases of color-blind observers, that the persistence of vision was abnormally great in those regions of the spectrum to which their blindness extended, accompanied by a curious sharply-localized increased persistence in another region.

Observations in this field are particularly valuable, owing to the indirect assistance which they offer to the very backward science and art of photometry. The method of observing persistence gives us a quantitative comparison between different eyes under the same conditions of illumination. We have no knowledge as to how closely different observers may agree in their consciousness of vision. The picture which one man sees when looking at a landscape may be appreciably different from the picture which his neighbor sees, even if both are apparently free from color-blindness, and yet we have no apparatus for comparing their sensations. It is quite conceivable that the average eye of the civilized man at this time may differ in its color appreciation from the eye of the average Greek or Roman of 2,000 years ago, in the same manner that the average eye of the present day is appreciably more nearly myopic than the eyes of our distant progenitors. If we could devise a perfectly definite source of light which could be accurately reproduced a hundred or a thousand years hence, we could make a series of observations of vision persistence for a number of representative observers, at this day, which should serve as a reference for comparing the vision of observers in the distant future. Moreover, the systematized study of the persistence of vision might furnish valuable material for assisting in the gauging of health and the diagnosis of disease.

## A Report on Submarine Boats.

The United States Naval Board on Construction has filed a report with the Secretary of the Navy, in which it is pointed out that the failure of the General Board of the Navy and the Construction Board to include torpedo boats in their building programmes for this year "may be accepted as conclusive evidence that they did not consider it advisable at this time to increase the number above those now authorized."

The board shows that it regards submarine boats as experimental and asserts that the tests of the Holland at Newport last year "were interesting and answered the purpose for which they were intended, namely, to instruct the crew, but nothing more." As to these experiments with the Holland the board says: "During the manœuvres of the North Atlantic fleet off Newport last summer, the Holland participated, making a surface run of seven miles outside Newport harbor, in charge of her naval crew only, and succeeding in getting within striking distance of the battleship Kearsarge without being discovered, due, no doubt, to her small size. She was ruled out, however, as the Kearsarge had already been put out of action by another ordinary torpedo boat, which also got within striking distance unperceived, and it has been stated that on account of the latter the vigilance of the lookouts on the Kearsarge had been relaxed when the Holland made the attack. Be that as it may, the conditions by no means simulate the actual warfare, and the Holland was not on that occasion used as a submarine boat, nor did she accomplish more than an ordinary torpedo boat. Without desiring to discredit the Holland in any way or to detract from her merits," the report says, "the board is of the opinion that the utility of the boats of this class has not been sufficiently demonstrated to warrant the construction of others than those already authorized—eight in number—which are considered a sufficient number to experiment with."

In conclusion the board had this to say: "Should Congress see fit to authorize any more submarine boats, the board is of the opinion that no special type should be specified, but that the Secretary of the Navy should have discretion to contract for such boats as in his judgment are likely to prove the most efficient and the best suited for naval purposes, thus opening up competition and giving other inventors a chance."

## A British Governmental World Telegraph System.

Sir Sanford Fleming has addressed a letter to Hon. William Mulock, the Canadian Postmaster General, at Ottawa, in favor of a State-owned telegraph service to girdle the globe. The letter is said to be the beginning of a movement to nationalize the cable and telegraph service of the British Empire. Sir Sanford claims that it is an opportune moment to consider a question which affects Canada as well as Australia. The arrangement for the establishment of the all-British cable across the Pacific Ocean has been completed. That arrangement implies joint ownership, and, in the opinion of Sir Sanford, is the harbinger of a complete system of State-owned telegraphs, by land and by sea, ramifying throughout the whole British Empire. The existing lines of telegraph between distant portions of the Empire, pass in part through foreign countries, or traverse shallow seas in proximity there to, where at a critical moment they are liable to speedy interruption. The rates, too, are said to be oppressive by reason of the monopoly. The reason the friends of the Pacific cable have never relaxed their efforts is due to the fact that the Canadian route between England and Australia is absolutely the only one by which the globe can be girdled by an all-British chain of telegraphs. With the telegraph system nationalized as suggested, Sir Sanford Fleming asserts that messages will be transmitted to and from the most distant British possessions at one-eighth or one-tenth the rates now levied by the companies.

This proposal to nationalize the telegraph lines throughout the empire, and that as a step to this end Canada should take over the lines of private companies in the dominion, has caused a great deal of discussion there. Prominent business men state that they had had correspondence regarding the suggestion before it was made public. This would seem to indicate that the dominion government has had previous knowledge of Sir Sanford Fleming's letter before its appearance. The difficulty of operating public lines in Canada, touching and merging in the lines of private companies at many points on the United States border, is an objection noted by those who are now discussing the proposition.

## In Favor of Pacific Cable.

At the regular monthly meeting of the New York Chamber of Commerce last week, Gustav H. Schwab, for the Committee on Foreign Commerce and the Revenue Laws, introduced a resolution (which was adopted) committing the chamber to favor the establishment of an American Trans-Pacific cable by private enterprise and to approval of "the general principles embodied in the Bill H. R. 2980, introduced in the House of Representatives by Mr. Sherman."

The report of the committee showed four reasons why private control was to be preferred over Government ownership:

(1) The first cost of a Government Trans-Pacific cable would appear to be at least $15,000,000.

(2) The cost of maintenance of a Government cable, it is estimated, would be at least $1,500,000 per annum.

(3) To be commercially profitable and useful, the proposed Trans-Pacific cable should reach Japan and China, but a United States Government cable would, in all likelihood, not receive permission from the Governments of Japan and China to land on their shores, as these Governments would naturally reserve the right to control every new cable landed on their coasts.

(4) The laying, maintaining and operating of ocean cables require a large amount of expert knowledge, based on experience, and in the opinion of your committee, no department of the Government is in a condition to supply these essential requisites.

## The Tarrant Explosion.

In his report submitted a few days ago on the fire and explosion last October in the building of Tarrant & Co., in New York City, Fire Marshal Seery recommends that the testimony be sent to the District Attorney, in order that he may aid in determining whether there was any criminal neglect on the part of Tarrant & Co. Prof. C. F. Chandler, in a sub-report, declares that the explosion appears to have been caused by the chlorate of potash in the third and fourth floors of the building. He said that such an explosion would cause a fire to burn with greater fierceness, owing to the amount of oxygen liberated. In the report proper it is asserted that the fire, which probably occurred before and started the explosion, might have been caused by the ignition of the tarred paper between the floors and ceilings by a spark from the electric wires, which had frequently been repaired and changed, with notification to the proper authorities, as provided by law. By the fire and explosion 7 lives were lost, 7 buildings destroyed and 35 others damaged, glass broken in 200 and a loss of $1,000,000 entailed. There is absolutely nothing adduced showing an electrical origin. In fact, the fire occurred at midday, when little or no current was on, although gas was burning.

## The Cost of Tearing Up Streets.

London has been suffering very seriously from the tearing up of her streets, but the proposal to construct permanent pipe ways has been met with objections as to cost. It would appear, however, that in the long run, the pipe way would be cheaper than the constant disturbance of the streets, leaving out of consideration the loss to business from the interruption of traffic. A well-known contractor has estimated that a huge tunnel could be constructed under the principal streets of the metropolis at a cost of £25 a foot. The subway would be sufficiently large to include every kind of pipe and wire, and allow of a 5-ft. 6-in. man walking upright through it. It is calculated that at present not more than 75 miles of London streets would need to be tunneled, as minor side streets could be left as at present. This would involve an expenditure of £15,000,000, a large sum that would have to be provided by the ratepayers. But it is suggested that in a few years' time the rent from various companies using the tunnel would show a handsome profit. This calculation is based on the fact that during the last five years the principal "road breakers" have spent no less than £10,563,741 4s. 5d. The three chief gas companies, taking no account of seven others that supply the suburban districts, have in the last five years spent upon road breaking £3,747,154 12s. 2d. In the same period thirty local authorities and companies who have the power to pull up roads when anything goes wrong with their electric-light cables have spent on that work £2,554,900. The water companies have given the professional road breaker work to the tune of £2,892,188 in the five years, and the telephone companies have disemboweled the streets at a cost of £1,369,498 12s. 3d. in the same time.

# The New Station of the Electric Vehicle Transportation Company—II.

(*Concluded.*)

BY R. A. FLIESS.

AS a cab battery of 44 cells weighs on an average some 1500 lbs. and over, it is evident that some rather elaborate method had to be devised to handle the 960 tons and over of battery which the battery charging room accommodates when full, especially as the speed with which this great weight of battery must be handled is an important factor. To handle the batteries in the charging room a 15-ton electric crane is used. Later a second 15-ton crane will be installed as a reserve, and for use at times of particularly heavy load.

### THE CRANE.

It has a 41 ft. 2½-inch span. It was built by the Morgan Engineering Company of Alliance, Ohio. It runs on a track some 300 ft. long, placed 11 ft. 4½ inches above the battery room floor. The rails on which it runs are supported by 20-in. steel girders fastened to the columns which support the ceiling of the battery room. Longitudinal registering racks are bolted to the web of each run-way girder, into which the driving pinions of the crane are geared. By this arrangement of positive drive the crane can never get out of true.

The crane is composed of two 3-ft. single web plate girders, spaced 4 ft. 9 in. between centers of webs, from which are hung ten battery lifting elevators. The hoisting apparatus is operated by chains wound on drums grooved in the form of a double right and left-hand screw, beginning from each end of the cylinder and running towards the center, forming a double winding drum, to which are attached two battery hoisting and lowering chains, and an auxiliary chain used to raise and lower the hoisting frame when the grappling hooks are open, and consequently free from the battery box. The auxiliary chain is connected by means of lugs to the top of the hoisting frame, and is guided centrally by means of an idler located directly under the hoisting drum. The auxiliary chain is wound on the drum in the opposite direction from that of the hoisting chains, so that, when the battery frame is lowered by the hoisting chains until the battery which it is supporting rests on the charging stand, the auxiliary chain is just tight, and takes the weight of the battery off the hoisting and lowering chains. Heavy counterweights connected to the four grappling hook arms by levers cause the grappling hooks to open and thereby release the battery. The frame is then lifted by the auxiliary chain. When it is desired to pick up another battery, with the same hoist, the battery frame is lowered by the auxiliary chain until the weight of the frame is taken by the hoisting chains. Then the grappling hooks close under the battery to be raised.

The crane is operated from a platform hung in the center. On the platform are placed the controllers which operate the crane-driving motors. Ten levers, within easy reach of the operator's hand, are fastened to the ceiling of the platform. Each of these is connected to a controller operating one of the ten hoisting frame motors.

There are many safety interlocking devices employed on the crane which can probably be described better by following the crane through a complete cycle of operations than by any other way. Suppose, for example, the craneman wishes to pick up a battery at the opposite end of the room from which he is. He moves the controller handle that operates the driving motor in the direction which he wishes to go, and the crane is propelled, at a speed of about 300 ft. per minute, by a Westinghouse 25-hp. series motor geared to a long driving shaft, the pinions on each end of which mesh with the longitudinal registering racks spoken of above. There are two 25-hp. driving motors—duplicates in all respects. Only one is used, however, to operate the crane. The second, with its controller, is for use in case of accident to the first.

When the crane has reached a position nearly over the battery to be lifted the craneman pulls the controller handle back to its zero position and applies a mechanical brake, which acts through a foot lever fastened to the platform on a big band brake attached to the driving shaft. When the crane has come to rest, if it is in the desired position, a lever on the back of the platform causes a bolt to shoot forward and catch in a groove cut in a flange fastened to the web of one of the 20-in. girders which support the crane. There are seventy of these grooves, each placed so that when the bolt locks in any one of them the crane is just centered over a row of batteries or a transfer train. The operation which shoots the bolt in place automatically opens the circuit to the driving motors and closes the circuit that operates the hoisting elevators which until then had been inoperative. The hoisting frame is then lowered, picks up the battery and raises it, as already described. Here again a safety device is employed to prevent the operator from starting his crane forward before the battery box has been raised high enough to clear the tops of the boxes on the racks. This device acts by locking the rod which controls the bolt in the groove on the girder until the battery has been raised high enough to clear the others. The rod is then automatically unlocked, and the operator may withdraw the bolt, which action opens the battery hoist circuit, and closes the crane operating motor circuit.

The crane is then moved until it is over the one of the six transfer railways, running across the battery room, on which it is desired to place it. The bolt is shot. The battery is deposited and the hoisting frame is raised, completing the cycle. If at any time the operator should forget to stop a hoisting frame there is an automatic cut-off arranged to be operated by it when it reaches a height slightly above the normal. This opens the circuit to the motor which controls that frame. So, it will be seen, all contingencies that it was thought necessary to look out for have been considered in the design of the crane. Power is supplied to it by a double trolley of No. 0 B. & S. wire strung along the ceiling of the battery room.

This room is ventilated by two 11-ft. fans, built by the B. F. Sturtevant Company of Boston. These fans, it is said, have a capacity sufficient to change the air in the battery room in between 3 and 4 minutes. The fans, a 60-hp. electric motor and other necessary paraphernalia, are installed in a specially constructed room situated on the roof of the building over the eastern end of the battery assembling room. The air is drawn out of the battery room through 10 ducts made of wood ranged at intervals along its north wall. The opening of the ducts is placed only a few feet above the floor, as the heavy acid fumes are thickest there. The room is heated by steam pipes strung near the ceiling, and is lighted by inclosed arc lights.

### THE BATTERY TRANSFER TRAINS.

It was remarked above that the crane deposited a battery upon one of the cars of a transfer train—six of which cross the battery room. This part of the equipment, illustrated in section in Fig. 7, was installed by the George T. McLauthlin Company, of Boston, represented in New York by Rumsey W. Scott.

From the sectional view shown a general idea may be obtained as to the operation of the transfer train. As will be noticed, the floor of the battery charging room is a few feet lower than that of the loading room—3 ft. 7 in., to be exact. A reference to Fig. 1 in connection with the section shown in Fig. 7, will show the six tunnels which reach from the battery room to the 49th street wall of the building under the loading room. In each of these tunnels a light railway of 2 ft. 8½-in. gauge is laid. This railway extends across the battery charging room. Each train is composed of five cars; each car can carry two batteries. Each train is operated by a cable fastened to one of the five cars. The cable passes over suitable pulleys placed at different points along the line, and is then carried up to the second floor close to the Forty-ninth Street wall of the vehicle-loading room. Here the cable is connected to an electric hoisting machine of the direct connected worm gear type operated by a special 6-hp C & C compound wound motor. The shunt field of the motor is kept in circuit all the time through two 220-volt lamps in series. This is done to reduce the starting current. It also improves the regulation. The motion of the train is controlled by a hand-reversing starting rheostat, which gives it proper speed regulation. This rheostat is placed within easy reach of the hand of the man who operates the hydraulic rams used for loading the vehicles, as seen in Fig. 8.

The hoisting machine, a view of which is shown in Fig. 9, has an electric brake attached to the driving shaft of the motor. This is always released before the armature circuit is made, and is thrown on when it is broken. The load that each train can carry is 15 tons, and the maximum speed is about 300 ft. per minute. The rheostat is so arranged that it is possible to regulate the position of a transfer train to within less than one-quarter of an inch. This close adjustment is necessary to enable the operator to center a battery over the lifting ram, and under the hoist frames of the crane. As will be seen from Figs. 1 and 7, the location of the loading stands close to the northern side of the loading room permits of each of the ten batteries on a train being brought into such a position that they can be lifted off their car by the lifting ram and a battery placed on each empty space with the minimum movement of the train. Each car is skeleton in make up to permit of the rams passing up through it,

and the cable is fastened to one side so as not to interfere with the operation of the lifting ram. There is an end automatic fastened to the cable winding drum so adjusted that it stops the transfer train, should the operator forget to do so, just before it reaches either end of its track. Also interlocking devices are connected to the transfer train and hydraulic ram systems by means of which a transfer train cannot be moved while the lifting ram is above its lowest position.

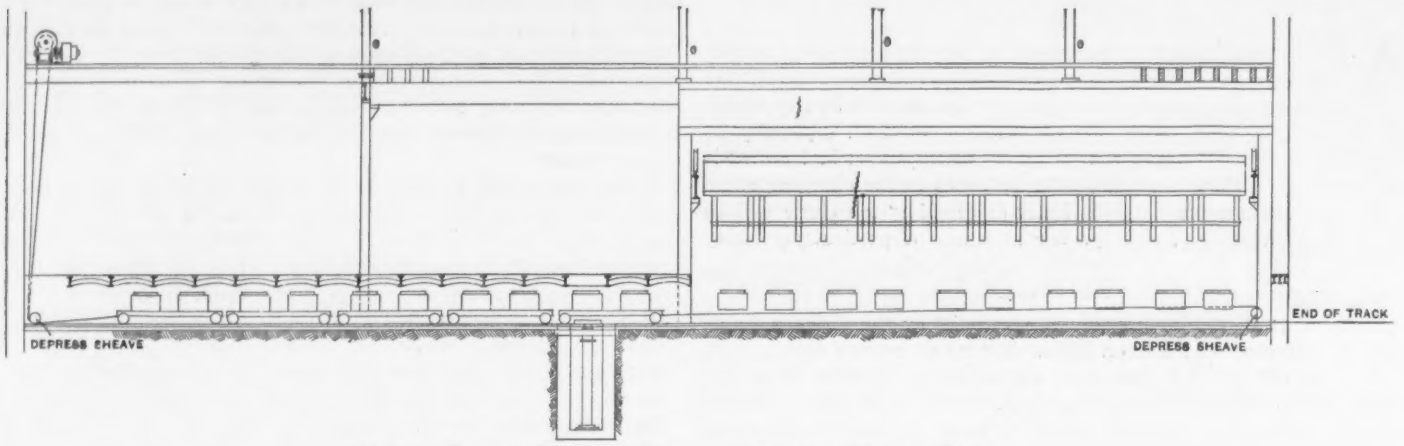



FIG. 7.—SECTION THROUGH BATTERY ROOM AND LOADING ROOM.

THE VEHICLE LOADING ROOM.

The loading room occupies that portion of the station situated directly behind the southern part of the vehicle assembling room, spoken of above, and connects with it by wide doorways. This room also has eight broad doorways which open directly into Forty-ninth Street; the room is 47 ft. wide by 302 ft. long. In it are placed six loading stands, three elevators and several inspection pits, as may be seen from Fig. 1 (last issue). The pits are so arranged that when not in use they are covered with a sectional wooden floor which can be taken up. When a pit is in use a guard rail, hinged in such a way that it can be made to disappear in the pit, is turned up and is held in place by a suitable support.

The three elevators, also installed by the G. S. McLauthlin Company, are of the platform carriage type and have a capacity of about 4500 lbs. and a speed of about 75 ft. per minute. The hoisting machines for each elevator are placed directly over the hoistway. They are of the direct-current worm-gear type and have extended drum shafts on which drums are placed at each end in order to get a direct lead for the hoisting cables attached to the platforms at their four corners.

A very important part of the equipment of an operating station for electric vehicles is that which is designed to take the discharged batteries out of the vehicles and place freshly charged ones in their place.

THE LOADING STANDS.

There are two cases, each of which must be considered separately when designing loading stands for electric vehicles. First, the case where the vehicle is so constructed that its battery must be run into the battery box compartment on a horizontal plane; second, the case where a vehicle is equipped with an underslung battery. In the loading room there are six loading stands, as was mentioned above. Four designed to load and unload end-loading vehicles, and two to handle under slung batteries.

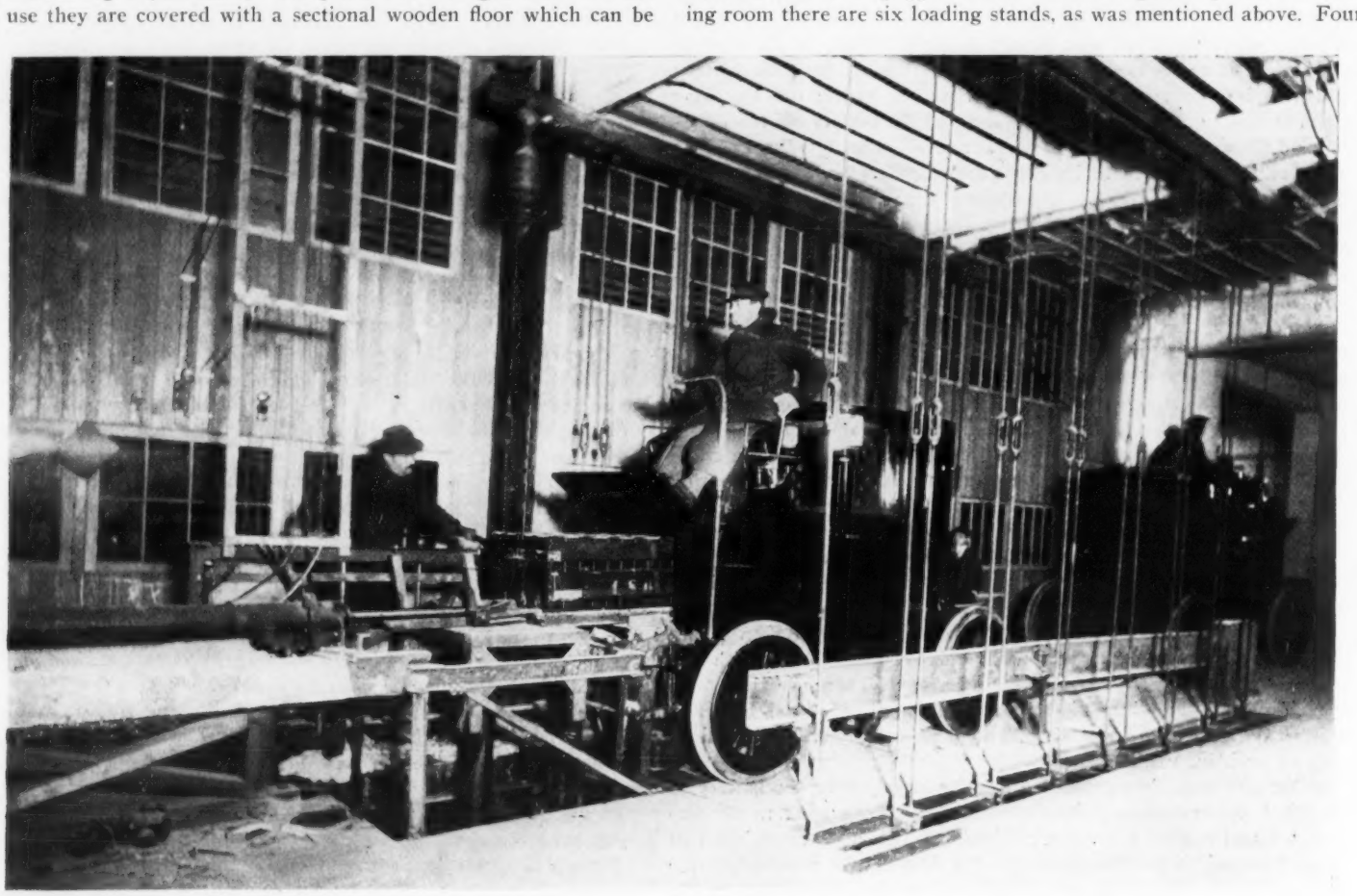


FIG. 8.—LOADING STAND FOR END-LOADING VEHICLES.

Fig. 10 shows a general view of one of the latest designs in loading stands intended for use with end-loading vehicles. Fig. 11 shows a section of the centering platform used with this stand. It is, of

course, understood that when what is called an end-loading vehicle comes into the station after a run to get a fresh battery, the vehicle must first be centred and then held in a certain definite and fixed position before its battery can be withdrawn by the horizontal hydraulic ram seen in Fig. 8. The centering of vehicles is done automatically at Stands Nos. 1 and 3 (Fig. 10) by a very ingenious device. This

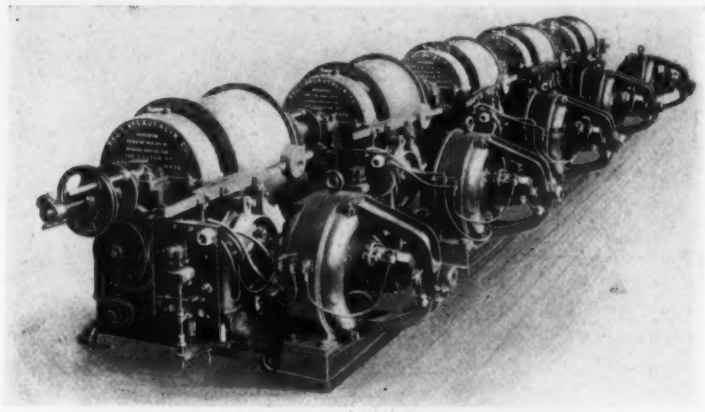


FIG. 9.--TRANSFER TRAIN OPERATING UNITS.

consists of a series of seven freely swinging platforms, each supported by four iron rods about 14 ft. long, hung from channels fastened to the I-beams which hold up the second floor of the building. Fig. 11 shows the details of this arrangement quite clearly. The principle upon which it works is very simple. As a vehicle enters the loading stand it is gradually guided to the centre in position for unloading and loading its battery by the contact of its hubs with the converging buffer channels shown in the illustrations. The weight attached

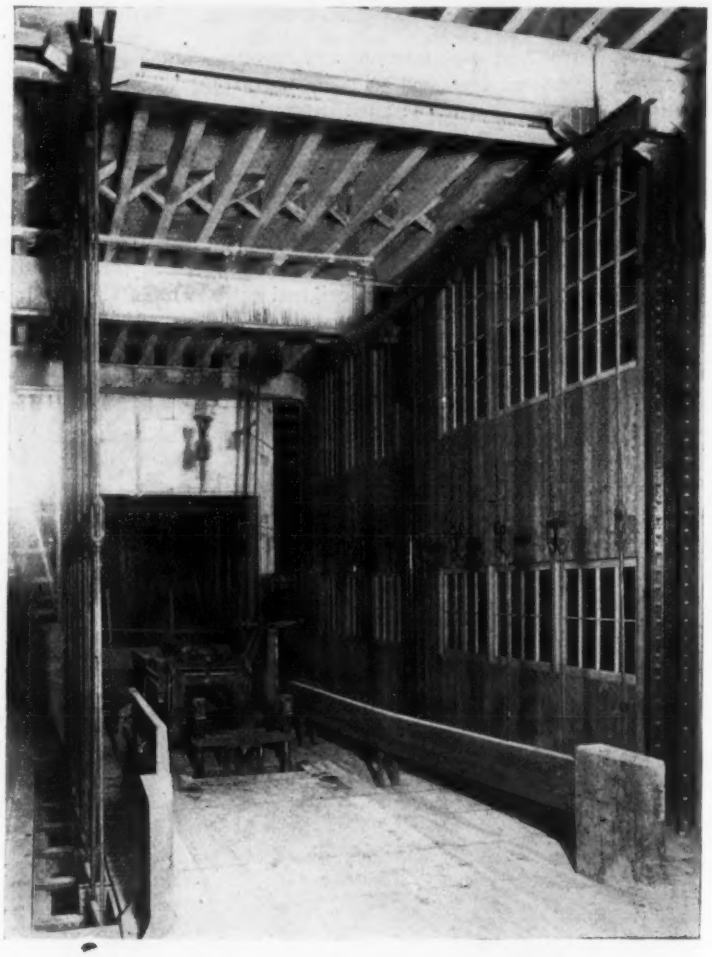


FIG. 10.—FERRY-SLIP LOADING STAND—GENERAL VIEW.

to the buffers produces lateral pressure. It also provides flexibility and reduces the jar of impact with the hubs. The weight has two chains fastened to it, each connected to a lever arm which supports the buffers. This provides equal movement of the buffers on the two sides. The operation of the centering device is comparable to the action which centres a ferryboat in its slip. The movable floor taking the place of the mobile water, allowing the side motion of the vehicle without any sliding of its wheels on the floor and the buffer channels taking the place of the flexible guiding walls of the slip.

Suppose, for instance, a vehicle enters the stand somewhat off the centre line; then the hubs of its wheels on one side will come in contact with one of the buffer channels. The weight fastened to the lever

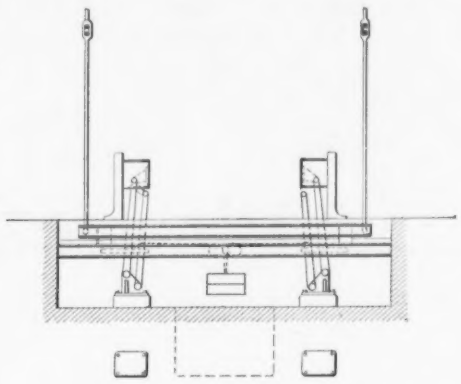


FIG. 11.—FERRY-SLIP CENTERING DEVICE—SECTION.

arm of the buffer channel causes a lateral pressure against the hubs which tends to crowd the vehicle to the opposite side. Since the platform swings freely laterally, they give to the pressure and the vehicle is carried over until its other hubs come in contact with the opposite buffer. Then the pressure due to the weight is equal on both sides, the platform stops swinging and the vehicle is centred. When there is no vehicle in the loading stands the buffer channels are kept a fixed distance apart by stops which act against the lever arms to which the buffers are fastened. Each buffer channel has a possible lateral motion of about 2 ft. Hence a vehicle which has longer axles than normal can be centered by the apparatus. The swinging platforms of the centering device have no appreciable longitudinal motion, as all such motion is prevented by suitable stops.

When the vehicle enters the loading stand it is run as far onto the movable platform as it can go. Fig. 8 shows the position of a vehicle when it has reached this point. It is then in contact with two iron straps fastened to the frame which guides the platform of the lifting ram, and is directly over the two hydraulic lifting rams situated under the platform of the centering device. These rams are shown in Fig. 10. They are operated by means of a single lever controlled by the man in charge of the loading stand. When the vehicle has reached the proper position the pressure is turned on and the rams engage the body of the vehicle at four points where suitable iron straps are provided. The rams lift the body of the vehicle several inches, until all the weight is taken off the springs. This is done to keep the vehicle battery box floor at a fixed level during unloading and loading, which could not be accomplished if the weight of the body of the vehicle were allowed to rest upon its springs. Fig. 12 shows in detail the

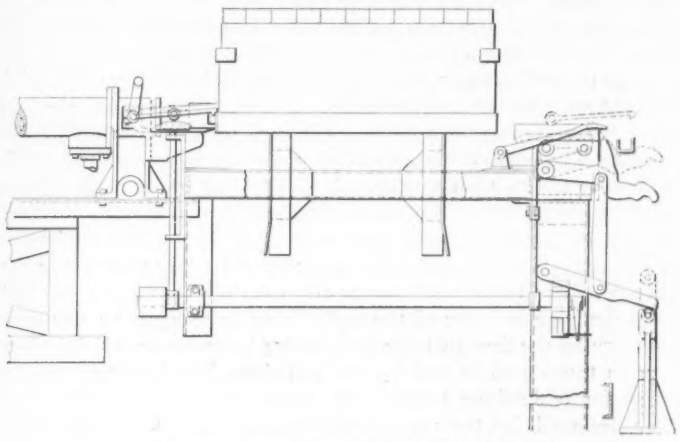


FIG. 12—DETAILS OF HORIZONTAL RAM.

operation of the horizontal hydraulic loading ram which is also seen in Fig. 8 in actual operation. The door which closes the battery box of the vehicle having been removed, the lever which controls the horizontal loading ram is turned and the ram advances until the hooks fastened at its end latch into iron handles fastened to the end of the battery box. The ram then recedes, pulling the box out of the

vehicle onto the platform of the lifting ram. The hooks are then disengaged by means of a foot lever, the operation of which is clearly shown in the illustrations. The battery box is lowered on the platform of the lifting ram until it rests upon one of the cars of the transfer train, which is then moved by means of the rheostat, spoken of above and seen in Fig. 8, until a freshly charged battery is brought into position over the lifting ram. This ram raises it to a proper level; the horizontal ram comes forward and pushes it into the vehicle, the door to the vehicle battery compartment is closed and the vehicle body is lowered till it rests on its own springs. When the vehicle-lifting ram has disappeared beneath the platform of the loading stand an incandescent lamp is automatically lighted, indicating to the driver that he can leave the loading stand.

Fig. 13 shows a sectional view of a battery-lifting ram in place in its pit; also the rails on which the transfer train runs. The hydraulic ram's centering platform and other details connected with the new loading stands were installed by the Watson-Stillman Company, of New York City. The battery lifting rams for the end-loading vehicle stands have a 5½-in. diameter plunger, an 8-in. water pipe and a lifting capacity of over 3400 lbs.

The hydraulic pressure required to operate the various rams is obtained by means of an accumulator placed in the battery assembling and repair room. This accumulator has a capacity of about 100 gallons and keeps a constant pressure on the line of 150 lbs. to the square inch. The electric pumps which feed the accumulator are also in the battery assembling and repair room, and are automatic in their action.

Loading stands Nos. 2 and 4 differ slightly from Nos. 1 and 3, just described. These stands are the two formerly used in the Fifty-third street station, where they gave good service for several years, but

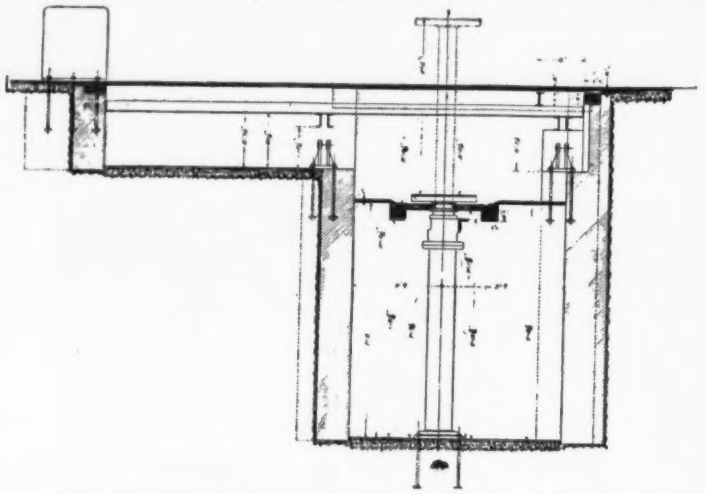


FIG. 13.—SECTION OF LIFTING RAM PIT, WITH RAM IN PLACE.

where, owing to the very cramped quarters of that station, it was never possible to work them to their full capacity. A description of these stands was given in the ELECTRICAL WORLD AND ENGINEER of Sept. 3, 1898. The only addition that has been made to them is a lifting ram, made necessary by the lay-out of the new station. The lifting rams are duplicates of those already described.

Loading stands Nos. 5 and 6 were designed for the use of vehicles equipped with underslung batteries. These stands employ the same device for centering the vehicles as is used with loading stands Nos. 1 and 3. The only difference is that made necessary by the fact that the battery has to come up through a suitable opening in the floor of the swinging platform. Of course, in these two stands the horizontal ram and its appurtenances are not used. The only difference between the lifting rams used for underslung and end-loading stands is in their capacity—there being a difference of an inch in diameter of cylinder and water pipe in favor of the underslung battery lifting ram, made necessary by the fact that the underslung batteries are slightly heavier than those used in end-loading vehicles. The loading stands required for underslung batteries are much less complicated than are those designed for the use of end-loading vehicles. When the six loading stands of the new station are working to their full capacity, and when the two cranes are operating in the battery charging room, the station should be able to change batteries in from 175 to 200 vehicles per hour.

In the vehicle-loading room are placed about a dozen ring washing stands for vehicles, by means of one of which two men can wash a vehicle in a very few minutes.

The photographs of the new station which illustrate this article were taken, as can be seen, before the station was entirely completed, and consequently cannot be considered entirely representative of what the finished plant looks like. It is thought, however, that they indicate quite clearly the very elaborate scale on which the new station of the Electric Vehicle Transportation Company is laid out.

The rolling stock equipment of the station consists, at present, of some 300 vehicles, which include hansoms, broughams, delivery wag-

FIG. 14.—A PIONEER HANSOM.

ons, wagonettes, victorias, phætons and surreys. The vehicles of the company have been described so many times recently in the various technical journals that no detailed description of them is necessary here. It was thought, however, that it might not be uninteresting to show the advance that has taken place in the general style, construction and finish of the vehicles of this company in the four years that have elapsed since the first introduction of commercial electrical vehicles for transportation purposes in New York City.

Fig. 14 shows one of the first hansom cabs operated commercially in the city. This was one of the original equipment of the Electric

FIG. 15.—ONE OF THE LATEST HANSOM CABS.

Carriage & Wagon Company, and was placed in service in March, 1897. Fig. 15 shows one of the latest styles of hansom cab used by the Electric Vehicle Transportation Company. The improvements that have been made in elegance of design, finish, etc., are readily ap-

parent. Fig. 16 illustrates one of the new 11-passenger wagonettes used for park service, etc. Fig. 17 shows an extension-front brougham. It has a seating capacity for four passengers inside, and room for an attendant with the driver. Fig. 18 shows a straight-front brougham. This can accommodate two passengers inside. The illustrations indicate the extensive field which the company is now covering.

FIG. 16.—ELEVEN-PASSENGER WAGONETTE.

Beside the Forty-ninth Street station the Electric Vehicle Transportation Company has several sub-stations in operation in different parts of the city. These are, of course, small and are only intended to accommodate a few vehicles at a time. They are established for the accommodation of such vehicles as are called upon to travel further from the main station than one charge of their batteries would ordinarily carry them. They are supplied with current from the Edison Illuminating Company's mains and are equipped with charging sets and a few battery racks on which a number of batteries are kept fully charged and ready to put in a vehicle. There are three of these sub-stations in operation at present. One in Vesey Street, one in Eighty-eighth Street, just east of Madison Avenue, and one at 100th Street, on the West Side. These will be enlarged as the necessity arise, or more sub-stations will be established.

Before closing this article the writer wishes to acknowledge his indebtedness and to express his thanks to Mr. G. H. Condict, chief engineer and general manager of the Electric Vehicle Transportation Company, for many courtesies shown by him while the data incorporated in this article were being collected.

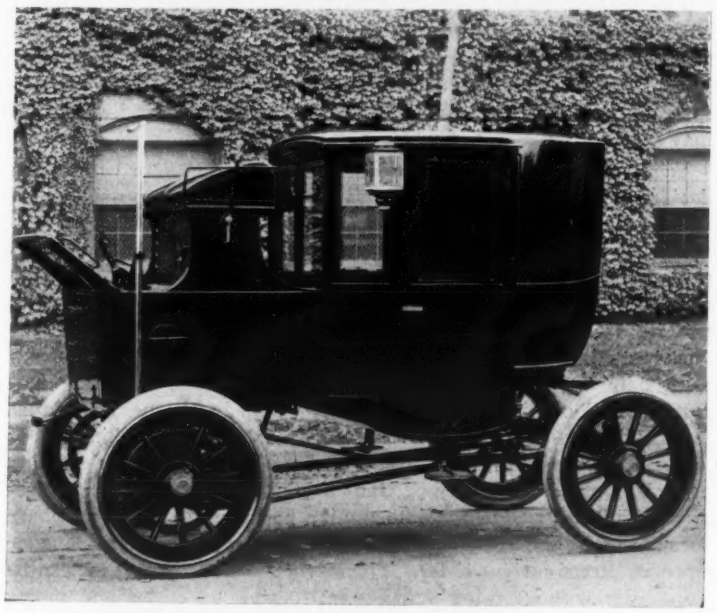


FIG. 17.—EXTENSION-FRONT BROUGHAM.

Doubtless in years to come the new, and, to us, mammoth station of the Electric Vehicle Transportation Company will appear as small and insignificant in comparison with those which the present century seems destined to see rise as does the little pioneer station of four years ago when compared with the Forty-ninth Street station. Yet, to those in whose minds the last years of the nineteenth century are still fresh, it is probable that an electric automobile charging station which has an available floor space that covers the equivalent of nearly three acres of ground can still excite some slight degree of admiration. In fact, it would seem as though this last production of the nineteenth century is worthy to serve as a monument to mark for future generations the beginning of the horseless age.

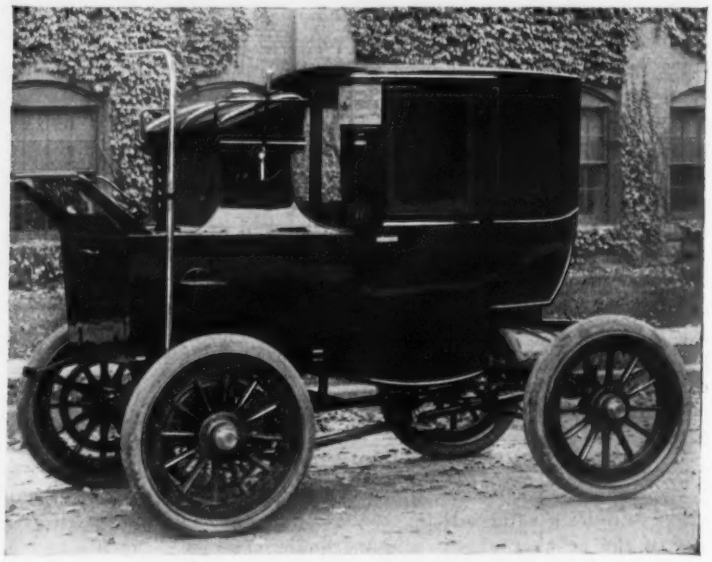


FIG. 18.—STRAIGHT-FRONT BROUGHAM.

## Inventions of the Past Century.

Mr. Levin H. Campbell, principal examiner in the United States Patent Office, reviews in the New York *World*, the development of American ingenuity during the past century, as it is recorded in the Patent Office, in the patents applied for and granted.

The primitive methods employed in agriculture and in almost every department of human industry one hundred years ago, he says, have witnessed improvements as great as these. Recall, for instance, the changes in artificial illumination since 1800. When the century opened the best artificial light was that furnished by tallow or wax candles. Then came the kerosene lamp, to be followed by illuminating gas, and this, in turn, to be largely displaced before the end of the century by the electric light.

The most wonderful developments of this remarkable century have been in the departments of transportation, agricultural methods and electricity. Each of these departments overlaps into the other, and each has been dependent on the development of the steam engine for much of the advance that has been made.

A mere enumeration of the leading inventions and discoveries of the century would make a long list. It would include the locomotive and the steamship, the telegraph and the telephone, photography, the invention of the reaper, the thresher and the many other machines and appliances which have revolutionized agriculture.

The records for the Patent Office for the century strikingly illustrate the progress that has been made. No statistics are available showing the exact number of patents granted one hundred years ago, but as the total issues up to 1836 numbered only 9957, it is not probable that more than a few score were issued in 1800. The issues for the year just closing number 24,660, and the total for the century will number, approximately, 673,000.

There is no indication that the inventive genius of mankind has reached its limits. The century now opening will witness advances in every department of science and art. It is difficult to predict along what lines the most remarkable developments will be made.

Just now there is an unusual advance in the development of self-propelling vehicles. This will doubtless be carried still further in the coming century, and it is not unreasonable to predict that the horse will have practically disappeared from the streets of large cities by the first of the next century. It is also not improbable that the problem of navigating the air will have been solved before the lapse of another century.

## The Future of the Electric Railway.

BY B. A. BEHREND AND A. G. WESSLING.

TO peer into the future and to forecast events is one of the services that science has rendered to humanity. That divine faculty of looking before and after marks out man from his lowly brethren of the animal kingdom. As it is fascinating to the philosophic mind to dwell upon the past and to draw from it general rules and lessons, so it is even more tempting to the thinking mind to extend the conclusions, to which a contemplation of the past has led it, to the predetermination of the future, just as the physicist, by producing an observed curve to a realm that he has not been able to explore, tries to fill out the lack of observation and experience.

The tendency of the human mind to wander back into the past and forth into the future, is deeply ingrained in human nature, and to the materialistic philosopher, it would be an inherent quality of the structure of the cerebrum. But though it is partly the office of science to occupy itself with future events, it is a paramount duty of science not to allow the human mind to run into apocalyptic visions, and to overstep the limits of what John Tyndall so appropriately called the scientific imagination.

The prophet's business is a thankless task. The great English historian and writer, Thomas Carlyle, is an illustration of this fact. Few, if any, of his predictions have come true, and his country, to which he prophesied doom and overhanging fate, has since his death risen to more greatness than ever was its own. The well-worn saying of the prophet who is without honor save in his own country, and in his own house, should make other prophets wary of so unprofitable an occupation. But if the probable development of an art is sketched without the cocksureness of the prophet, if it is considered with full knowledge of its being worth not more than any other apocalyptic vision, the effect, though perhaps not being eminently useful, will certainly not be injurious.

The following is a brief sketch of what may, or may not, be the evolution of the electric railway in the century the threshold of which we have just overstepped.

While the electric motor dates its origin in 1873, it was not until five years later that electricity as a motive power for the propulsion of street cars was adopted in Richmond, Va. One of the first changes brought about by this move was a change in the exterior shape of the motor, which gradually resolved itself into the present universal type of enclosed weatherproof form with not more than one reduction in speed between armature shaft and car axle. At the same time all kinds of systems were tried, every one of which helped either in a negative or a positive way to prove the advantages of our present system. Shunt wound motors soon showed they would not operate satisfactorily, and a system using a constant current was just as little suited to such service. The characteristics of the series wound motor working at a constant potential are such as to make it peculiarly suitable to meet the requirements of railway work. Its variation in speed with load is, as it were, an automatic safety device, which protects it against overloading itself, by reducing the rate at which it works as soon as it is called upon to increase its torque. Of course, higher speeds will be constantly demanded, which will necessitate the use of motors of increased capacity, but it is safe to predict that as long as direct current is used as the motive force the series wound motor will hold its own. Higher voltages will also be used, but the danger to life will not allow present limits to be greatly exceeded when using the present system of overhead transmission. The desirability of using higher voltages, together with the popular demand that all overhead wires be removed, will soon result in the adoption of the underground conduit system, at least so far as the cities are concerned.

As regards interurban traffic, there will be an extension of the present systems, but the present system of direct current transmission will not be used to replace the steam locomotives on our great trunk railroads. If direct current is to be used for this purpose, we may expect to see a modification of the Heilmann locomotive. The advantages possessed by the multi-unit train would lead to the adoption of trains made up of several motor cars, combined with one or more cars equipped with boilers and high-speed engines direct connected to direct current generators for producing the requisite electrical energy. The advantages of such a system would be the saving in weight of the generating car, since it would not then be necessary to carry such enormous weights on a few pairs of driving wheels as is now the case. The propelling force of the train being applied to the axles of the cars would do away with the pounding now caused by the reciprocating parts of the engine being directly connected to the drivers, and would greatly reduce the cost of repairs of the roadbed. Radiation from the present exposed surfaces of boilers and cylinders could be greatly reduced, and would result in a material reduction of the fuel burned. The generating cars could be made uniform in size and design and of capacity sufficient for trains of only the minimum or perhaps the average number of cars. By using two or more generating cars, working in parallel, trains of any desired number of cars could be operated and controlled as easily as at present.

While reviewing the history of street railway development, the storage battery must not be overlooked. The attempts that have been made to introduce it into actual service have clearly proved that there is little to be expected from it as a source of motive power. It has a place in the central station for taking the peak of the load, and future development will not be greatly affected by the storage battery. The only form of battery from which we may hope for great achievements in the future is one that will transform coal directly into electrical energy, in a manner more economically and directly than it can now be done by the use of the steam engine. A car equipped with a battery of such a kind could then be used in place of the generating car above mentioned. If the size and weight of such a battery could be small enough, it might even be feasible to equip individual cars therewith.

Turning from direct currents to alternating currents, there is no doubt that the polyphase induction motor promises to take the place of the direct current motor in all those cases in which overhead wires may be employed. Necessitating, as it does, two overhead wires instead of one, there still remains a great deal to be done in the application of three-phase currents to street railways. The alternating current flowing through the rails cannot injure water pipes through electrolytic action, and this may be an offset for the greater drop caused by the inductance of the iron rail. The overhead system, complicated enough for direct currents, becomes fearfully complicated with three-phase currents, and the streets of the cities would be covered by cobwebs of wires. Whether engineering difficulties, or æsthetic circumstances, will be in the way of polyphase electric traction we have no means of determining to-day. There was just as much objection ten years ago to the direct current trolley as there is at present to the two trolleys of the three-phase system.

The induction motor is surely at present the ideal motor for electric traction, at least as far as interurban traffic is concerned. It operates at practically constant speed, producing almost any torque it is capable of developing at all. It starts under load and if its winding is properly made, the heaviest starting currents are unlikely to injure it in the least. No precarious collectors, no sparking, no flashing over, and no bucking are to be borne up with in these motors.

The series-parallel control of two induction motors in the same truck permits of a reduction in speed to one-half, and the elaboration and development of this concatenation of induction motors may bring to light new, and, so far, unthought of possibilities for this system. It has already found application to mountain railways, and may be promised a wide field.

While the nearly constant speed of the induction motor would be a decided advantage in interurban railway work, the impossibility of overstepping synchronism is as great a disadvantage for trunk railroads. It often becomes necessary to make up lost time, and this is not possible if the motors are fed from a line the frequency of which cannot be changed. This would logically lead to the use of special generating sets for each train, the frequency of which could be changed within certain limits. The locomotive of the Heilmann type, only equipped with polyphase generators and induction motors, instead of direct current motors, would be the next step that might be taken, and whatever one may say about the combination of a steam engine with generators, and of the latter with motors, and about the irrationality of transforming motive power into electricity and electricity back into motive power, surely the polyphase locomotive of the Heilmann system would present a great advance upon its direct current sister. The starting of such an engine can be done even without using starting resistances, generator and motor being started up together, and the excitation of the generator might be derived from a small storage battery, or from separately driven exciters. With such engines very high speeds may be attained, and very heavy trains may be hauled.

There is no doubt, however, that the very conditions which gave birth to the Heilmann locomotive will lead to an improvement of the

steam locomotive as at present in existence. The inertia of the human mind has not yet succeeded in getting away from the general plan Stephenson gave to the locomotive. But there are waiting for application the vertical steam engine of the Schlick system, doing away with the lifting up and pounding down of high-speed locomotives, and the steam turbines of De Laval and of Parsons. A severe struggle for existence is in store for the present locomotive as well as for all new inventions using electricity as driving power for the motors. Natural selection, sitting high above the lists, will judge the contest and award the prize to the strongest and fittest.

The near future will doubtless avail itself of the higher voltages that could easily be turned to account in polyphase traction.

Single-phase induction motors may be improved upon and perhaps the time of their application to railroads is not so distant as many of us suppose. But who can tell what slumbers in the lap of the future?

The preceding are but a few predictions of the developments that may be expected as the logical result of the persistent striving of engineers in this direction. But when such natural growths are aided by such startling discoveries as were recently made public by one who may be ranked as the most fertile and inventive genius in his line, the results obtained will far surpass our expectations. Regarding the transmission of energy, he states: "Thus the discovery of these new properties of the atmosphere not only opened up the possibility of transmitting, without wires, energy in large amounts, but, what was still more significant, it afforded the certitude that energy could be transmitted in this manner economically. In this new system it matters little—in fact, almost nothing—whether the transmission is effected at the distance of a few miles or of a few thousand miles." May we then hope to see every natural source of energy on the globe, including waterfalls, tides, winds and sunshine, transformed into electrical energy, which will then be transmitted to any point where it may be desired to use it? Having an unlimited amount of power available, the speed at which electric cars can then be run, will be limited only by the strength of the materials used in their construction. For the same reason their time of acceleration and of retardation will be reduced to as small a period as the sensibilities of their passengers will permit. This, from our present standpoint, seems to be the limit in the development of electric railroads which we may hope to attain.

But many unphilosophical minds, in dwelling upon future events, believe that the curve of development and improvement is still far from its maximum. Nay, more, they believe that, as they have watched an ascendancy during the past century, the slope of the curve will remain positive and there never will be an end to improvement. As Lord Kelvin once remarked, quoting Immanuel Kant, these people are like Fontenelle's roses, who looked upon their gardener, saying: "Our gardener must be a very old man; in the memory of roses he is the same he has ever been. It is impossible that he can ever change or be other than he is." Evolution does not necessarily mean progress, and as our globe is in a state of cooling, the time must come for the earth when evolution will mean adaptation to a universal winter, and as the great cosmos will finally end in destruction, as each individual passes from childhood to a maximum of development and then into death, as nations rise and fall, so will the industrial development, doubtless at present near its climax, go down as it has risen, only when and how is not revealed to human ken.

## Telephone vs. Telegraph on Railroad Lines.

BY G. F. JENKS.

THERE is a story going the rounds of the railroad columns of the newspapers to the effect that one of the large railroads in the far West is about to give up its telegraph system and substitute a telephone system therefor. This is perhaps as likely to occur as that this road is about to use typewriters exclusively and give up entirely the use of pen and ink.

Of course telephones are largely used by our railroads, both in their own work and in communicating with the public. The Philadelphia *Record* has recently printed a careful account of the telephone system of the Pennsylvania Railroad Company, which we may presume is as extensive as any in the country. The *Record's* picture of the central switchboard, located at the Broad Street Station, Philadelphia, shows that four telephone operators are employed at once, more than are needed at the "Central" of many sizeable towns, and the article states that this railroad exchange is connected by lines under the control of the railroad with smaller railroad exchanges at all important points on the lines between New York, Washington and Pittsburg. This is evidently a telephone system of some importance, and yet we understand that the telegraph system of the Pennsylvania Railroad is as extensive as ever, and we cannot learn that any change is contemplated in its methods of dispatching trains or other telegraph work.

We gather from the proceedings of the Association of Railroad Telegraph Superintendents and from various items in the daily press, that the New York, New Haven & Hartford Railroad has a railroad telephone system second only to that of the Pennsylvania. This railroad has a chain of exchanges between New York and Boston linked by wires, some supplied by the telephone companies, and others owned by the railroad. But here again the telephone is used only to supplement the telegraph, and there is no talk of superseding one with the other.

Many other railroads could be named with more or less complete systems of telephones. The New York Central, the Lehigh Valley, the Lackawanna, the Baltimore & Ohio and others use telephones extensively, but upon all of them the telegraph is kept in its usual state of efficiency.

There are various reasons why the telephone should not supersede the telegraph in railroad work. The first reason is its greater cost. Speaking generally, two wires are needed for a telephone circuit, as against one for a telegraph circuit. Of course, there are many isolated cases of satisfactory "grounded" telephone circuits, but they are generally short lines and at a distance from the large towns where electric power plants make the "ground" lively and grounded lines noisy with their escaping electricity.

Whenever considerable distances are to be covered and more than one circuit put upon a line of poles, it is safe to say that two wires must be used. Nor is it enough to provide two wires. If they are to be of any length, they must be of copper, while on most railroads iron is plenty good enough for the telegraph. Now, copper wire of the usual weight costs fully twice as much as the ordinary iron telegraph wire, so that it is fair to say that an efficient telephone circuit will cost the railroad four times as much as a telegraph circuit of the same length. This high cost of long distance telephone lines is a chief deterrent to their general use, by the railroads as by the public, and we should not be surprised if the use of their long-distance telephone wires were strictly limited to important communications even on the railroads controlling through circuits.

A second difficulty, akin to the first, is that a telephone circuit can only be used for one conversation at a time, while a telegraph wire, by the introduction of the various duplex and quadruplex systems, can take two or four messages at once. To be sure, these systems are only adapted to circuits connecting two or three stations, but the longest circuits seldom connect with more.

In railroad work the shorter or "division" circuits usually connect with every station on the division. It is quite usual for "train wires" and division "message wires" to connect with forty or fifty telegraph offices, and here we reach a third case where the telephone is at fault.

Transmitters and receivers might work well enough under such circumstances, but no telephone signalling apparatus is available which will work on a single circuit to fifty stations at once. If such an arrangement were tried it would probably be necessary to retain the old telegraph instruments to signal the various offices.

On the other hand, it is hard to see that the telephone possesses advantages in the handling of the message business now sent by telegraph that would warrant the increased expense involved. There might be emergencies when it would be extremely useful to the railroads to be able to fill the places of some of their telegraphers with "telephonists," but in such circumstances it is probable that temporary telephone circuits could be improvised from telegraph wires as quickly as the "telephonists" could be secured, so that no permanent expense on this account would be justified.

In point of fact, although the telephone is nearly half as old as the telegraph, it shows no signs of absolutely replacing it, either with the railroads or the public. Before the advent of the telephone, a man would divide his correspondence into two parts, one to be done by telegraph and one by letter. Now we make a third division. When we think we need a well-nigh immediate answer, we telephone, risking a waste of time through slow connections or a reply of "busy." If, on the other hand, a reply within a few hours will do, we telegraph, and we prefer to telegraph.

## The Exchange of the Atlanta, Ga., Standard Telephone Company.

FIG. 1.—ATLANTA STANDARD TELEPHONE EXCHANGE.

ONE of the most interesting and novel of the recent "independent" telephone exchanges is that equipped for 3,000 subscribers by the Sun Electric Manufacturing Company, of Philadelphia, for the Atlanta (Ga.) Standard Telephone Company. We are indebted to Mr. E. E. Clement for a number of details in regard to the work, the exchange having been installed under what are known as the Clement & Gharky patents by the Atlanta Standard Construction Company.

The exterior of the exchange building is shown in Fig. 1, while Fig. 2 illustrates the operating room. The cables from the distributing board, coming up at the left, are taken from the top of the chute onto brackets supported on vertical hardwood studs secured along the walls, 25 ins. apart. The switchboard is divided into sections of three positions each, and there are struts to each section, a pair of cables being let off from every third strut, beginning with the lowermost pair, and across the top of the board to the connecting terminals. The chute through which the cables pass up to the operating room is provided with doors on each floor, so that it can be opened for its entire length, and the same arrangement is followed with the chute through which the line cables pass up from the vault in the basement to the distributing board, perfect accessibility of every part of the line, either individually or in all its cable, being thus secured. The board is divided into sections of three positions each. Two of these positions are taken by "A" operators, who answer all calls and initiate trunk connections, the third position being taken by a "B" operator, whose sole duty is to complete trunk connections according to instructions received from the "A" operators. This "B" operator does neither ring nor talk to any subscriber except when the line wanted is busy. Her sole work is to insert plugs, and the "A" operator does the rest. When the work is very light, all but the "B" operators can be released, in which case these operators take up the work on the adjoining "A" panels; in order that they may do this, switches are provided on the right and left of each "B" panel, as shown, to connect the head circuits together.

In Fig. 3 is a section of three positions in course of erection, with parts removed to exhibit the inside construction. An inclosed gallery passes all around it, perfectly clear of cables or other obstructions. Behind the left-hand transmitter is a continuation of one of the struts, bored to receive the horizontal members of a trunk cable frame. The trunk cables run along the wainscoting of the wall, where they are not only out of the way, but absolutely open and accessible all the time. They cross the floor of the gallery, accessible under short sections of false flooring raised 3 ins. At every third strut along the wall a pair of line cables is led off and taken across the top of the board to the front behind the moulding down through the roof. The braided covering is removed and the wires are formed and laced to come down to the inside ends of the terminals on the top of the vertical strip. The eleventh pair of terminals on each strip and the eleventh opening in each case shown unfitted with a line unit are "extras." These openings are normally plugged. In each section of the switchboard there are 20 vertical line strips, carrying normally 200 line units. The first and tenth, and the eleventh and twentieth strips, however, each carry an extra unit the same as a line unit, wired to the chief operator's desk for one and the trouble operator for the other. The "A" operators call the chief just as they would a subscriber, her desk being fitted with a row of annunciators consisting of plungers which also serve as keys, and which, when depressed, put her telephone set into circuit.

Each line unit is carried on a yoke secured to the back of the strip, the relay being of tubular form, and the lamp fitted in the front end of the tube. This is closed on the outside by a bull's-eye of translucent material (right-hand strip in Fig. 3), the bull's-eye being removed from the other strips in that engraving, leaving the lamps exposed. Below the line strips the trunk panel is fitted with jacks and order keys. The panel in Fig. 3 is bored for the full equipment for 4000 lines, but with jacks for only 1000 installed. These are plain open-circuit jacks, each connected to its individual trunk line leading to some particular "B" section. In actual service it was found that two trunks from each "A" to each "B" operator was sufficient, giving four on each double "A" panel that lead to the same operator. The order keys at the top correspond with the pairs of trunks, the order circuits being separate from the trunks. The trunk and order-circuit cabling is wired on the trunk panel before it leaves the factory, and the connections are at one end, where the cable passes down the leg of the board and thence under the floor to the rack in the rear of the gallery.

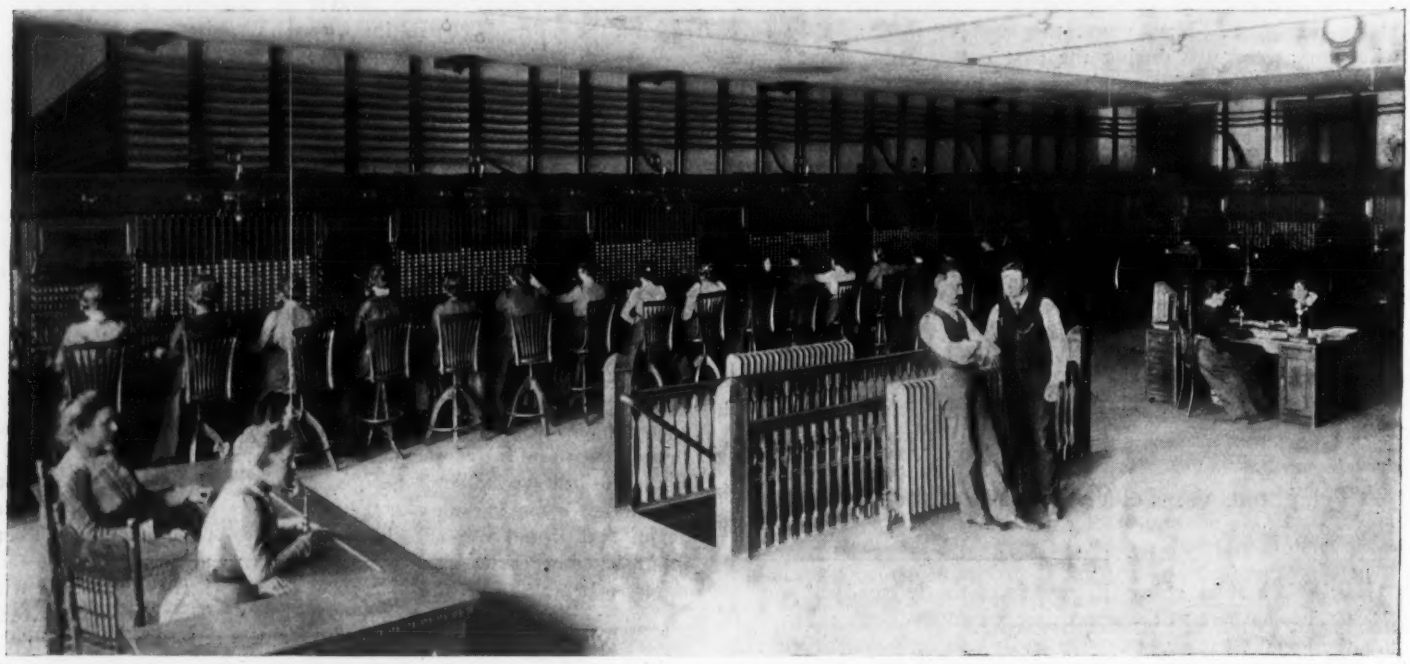


FIG. 2.—MAIN OPERATING ROOM INDEPENDENT TELEPHONE EXCHANGE, ATLANTA, GA.

Below the trunk panel, and extending across each double "A" section is a signal panel, and directly in front of this are the "operators' strips," a series of units composing the horizontal table. Each strip is of five-ply wood veneered on its surface with black fibre, and carrying a pair of plugs and a combination key. The calling plug of each

pair has a switch in its seat which, as long as it is not in use, connects the operator's head telephone to the corresponding cord. No listening key is required, therefore, for as soon as the operator has inserted the answering plug in response to a call she is already on the line. The combination key in one position connects the generator to ring, and in the other position it connects the corresponding signal lamp back of the plug to act as a supervisory signal, leaving it connected until the called subscriber answers, when it is automatically thrown off. This key, the plugs, and the plug seat switch, are all wired in grooves in the edges of the strip before leaving the factory.

On the right of Fig. 3 is section B, which consists of a cast-iron panel in two parts, made in "stair-steps," and drilled through with rows of holes for the plug seats and "B" signals. The former are plain plug seats, tubular in form, held in place by a shoulder on one side of the iron and a nut on the other. The latter are plungers which serve both as push buttons and as signals. The row of these in front of any "B" operator represents all the "A" operators in the exchange, and when one comes out it signifies that the corresponding operator has come in on a trunk leading to one of the two plugs below it. This signal is only intended to guide the eye, for it is operated by the "A" operator having pressed her order key on the trunk panel for this particular "B" operator, and as soon as she has done that she has crossed her talking circuit with that of the "B" operator and gives the order orally for the connection; but the visual signal is found to be useful in many ways.

Should several trunk signals come in at the same time, the orders would be confusing to the "B" operator receiving them, but they are made non-interfering by a "lock-out" mechanism which prevents more than one signal coming in at a time. At the same time, if the "B" operator happens to be busy, the signal shows her who called, and she can ask for the order to be repeated by simply depressing the plunger to its fullest extent.

The wiring on the rear of the "B" sections, as well as the management of the cords and weights of the trunk plugs, is simplified by inverting the plugs; this also gives an opportunity to use long cords, which permit the trunk plugs to be used over a large part of either of the two adjoining "A" sections, as indicated in Fig. 4.

In the operators' suspension sets the transmitters are suspended by bare conductors, which pass over insulated sheaves. This allows the conductors to be reduced so that they are almost imperceptible, and do not obscure the view of the board. The sheaves are carried on a sliding support, locked in position by the weight of the transmitter, the operator being thus able to adjust her transmitter up or down, inward or outward, by merely raising it in her hand. An automatic switch is operated by a stop clamped on the cord so that when the transmitter is pushed all the way up by a retiring operator the battery is cut off. The head telephone is plugged in on a jack underneath the table in the ordinary way.

The board works with a central battery for signalling. Local batteries are used at the subscribers' stations. The subscriber calls by removing his receiver from the hook. This act closes the battery circuit and current flows through one coil of his relay, which closes the lamp circuit. The "A" operator, perceiving the signal, inserts the answering plug of a pair, and being already on the cord, is enabled at once to ask "number." If the number wanted is on her own section she inserts the calling plug in the jack of the line wanted and pushes the knob of her key in one direction at one operation. This connects the lamp signal corresponding to that pair of plugs, and a reverse motion of the key rings up the subscriber. The previous insertion of the answering plug connected the line relay in a bridge circuit, presenting high impedance to talking current but permitting the battery current to pass neutrally and retire the signal. The supervisory signal, however, remains lighted until the called subscriber answers, and it is therefore unnecessary for the operator to listen in. As a matter of fact, she has no means of listening in after the connection is made. When the called subscriber answers, the supervisory signal disappears, and a clear through circuit is established between the subscribers, with no branches or coils, and only one pair of cord contacts, interposed. Either subscriber can control his own lamp signal by moving his switch hook, and when both have hung up their receivers both line lamps are lighted for clearing out. If one lamp only should light, it would either be a sign of trouble or indicate that one subscriber had neglected to hang up his receiver.

When the line wanted is not within reach, the "A" operator inserts

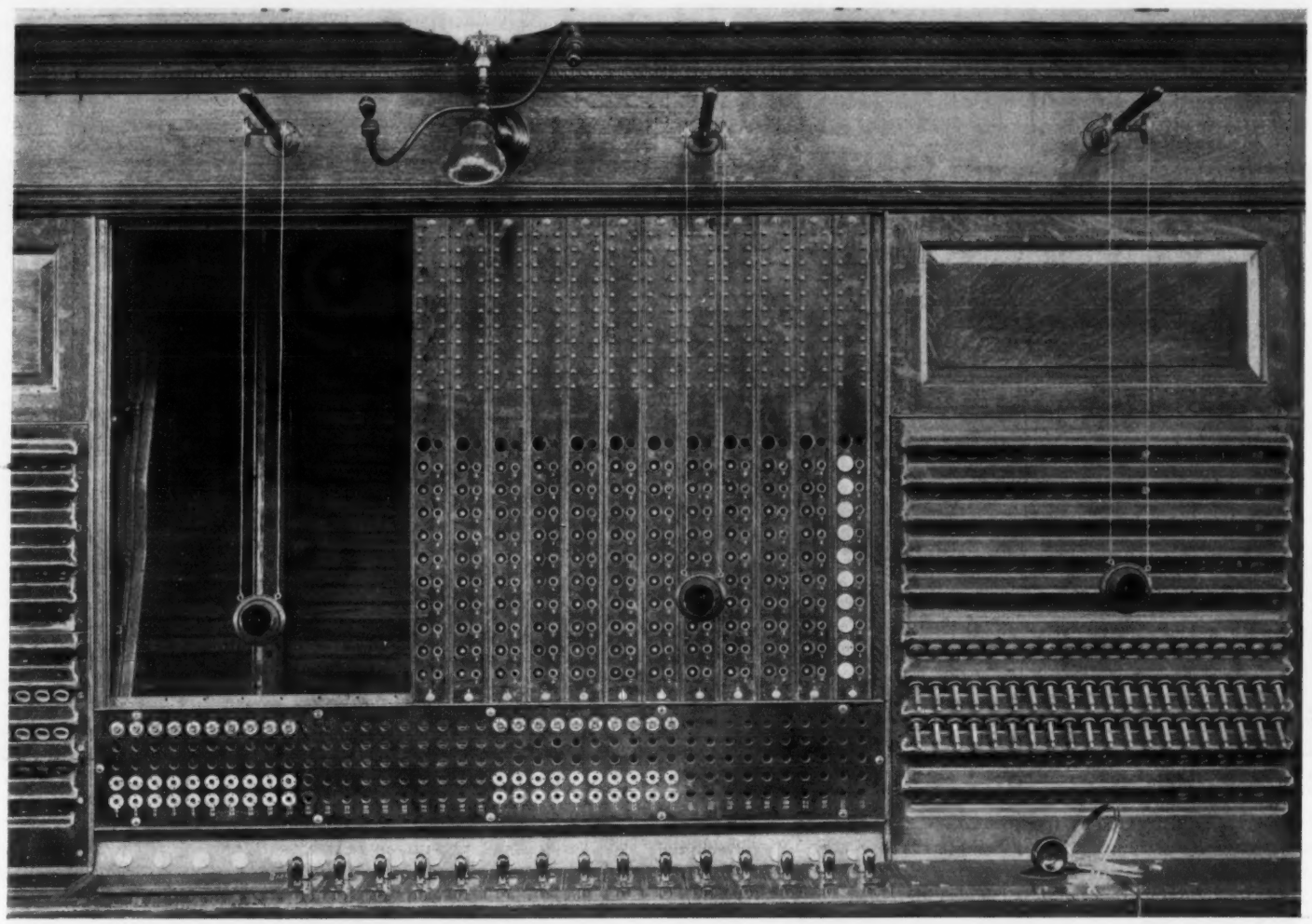


FIG. 3.—DETAILS OF ATLANTA EXCHANGE SWITCHBOARD CONSTRUCTION.

the calling plug in the jack of a trunk leading to the desired section, at the same time pressing the corresponding order-key and repeating the number to the "B" operator, and pulling the knob of her combination key as before. The "B" operator takes the proper trunk plug and inserts it in the desired jack. The instant she has done so a circuit is completed for the supervisory signal in front of the "A" operator, who is thereby informed that the connection is complete and proceeds to ring. There need be no delay in the "A" operator's work, because of a slight delay in the completion of the connection; for the lighting of that lamp always means the same thing—that is, she is to ring, and the order cannot be lost, for the "B" signal will bring the "B" operator back on the order circuit if she has missed it. When the subscriber answers, the supervisory lamp goes out, and when the conversation is finished the clearing-out signals are received at both ends as before. In case a line is busy, that is, if the "B" operator finds a plug already in the jack, she speaks directly to the calling subscriber through the trunk wire, informing him that the line is busy, and in hanging up his receiver he gives the clearing-out signal; or should he neglect to do so the "B" operator can directly inform the "A" operator of the fact.

An arrangement of multiple trunks, instead of the simple trunking described, is furnished where trunking between exchanges is to form a considerable percentage of the business. For this purpose a set of busy signals are used in addition to the supervisory signals shown. The desk at the left-hand side of Fig. 2 is a monitor's desk, fitted with listening keys only, so that the monitors can listen to or talk with any operator or the chief. Where conditions permit, this desk is also fitted with a distributing board for all the operators' circuits, and "on and off" keys giving control of the individual operator's battery connections, to insure economy. The chief operator's desk is also fitted with a limited number of special line units, whereby "kickers" among the subscribers can be accommodated by the chief herself.

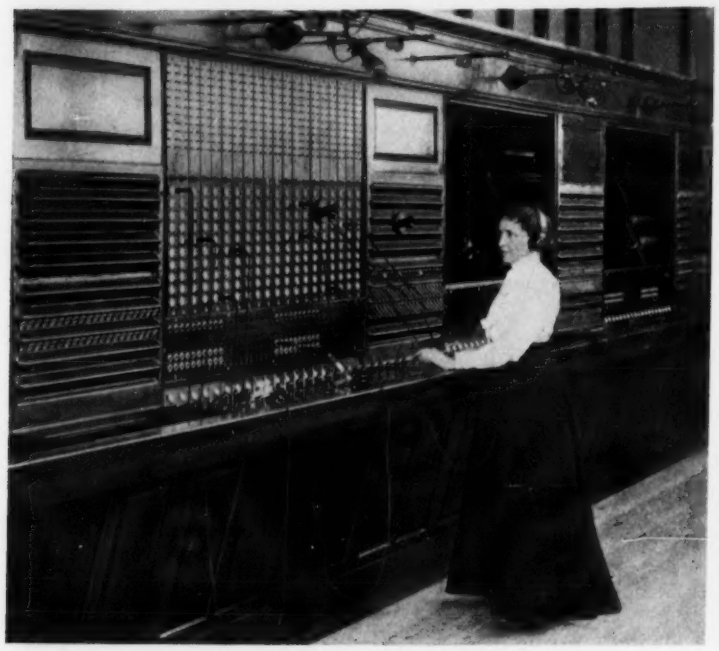


FIG. 4.—PANELS IN OPERATION.

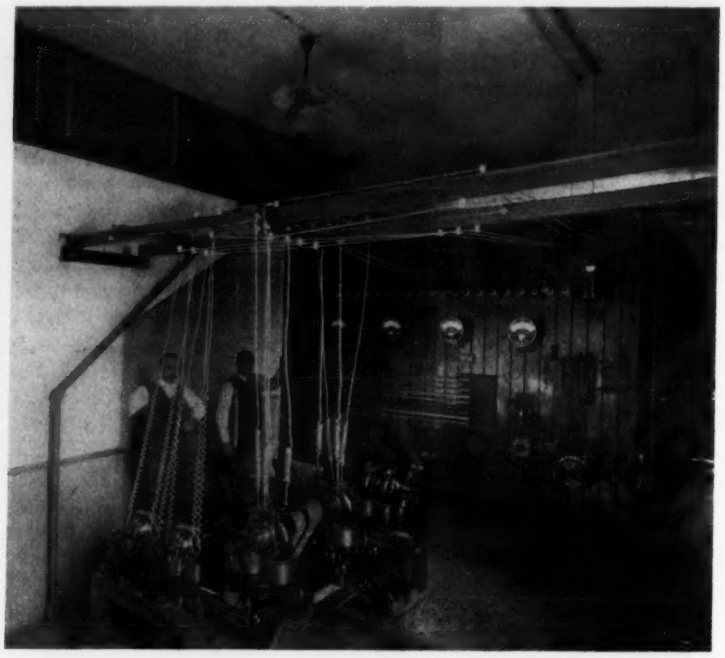


FIG. 5.—POWER ROOM.

The power room, with its switchboard, and one side of the combined cross-connecting and distributing board is seen in Fig. 5. The cables enter at the right-hand side from beneath and pass under a false floor, being brought up in rows along the sides of the distributing-board frame, an iron structure formed of angles and tees forming a cage with cross-bars overhead of iron pipe carrying vertical pins 5 ins. in height arranged in rows; each pin has a sleeve of hard fibre slipped over it to prevent short circuits or crosses in case the insulation on the jumper wires should break. The cage has two partitions inside, and each of these is faced with hardwood panels, as are also the two sides and the back. Each cable is brought up to the foot of the panel and there fitted with a pot head, the wires from which are formed up and led to rows of pairs of brass terminals passing through the panel. On the outside of each panel is a corresponding row of fuse protectors on porcelain bases, to which the cable wires are connected. From each fuse block a continuing pair of wires is threaded back through the panel and up the inside face to the top of the frame, where it is led along between the parallel rows of pins to its appropriate terminals on the rear face of the board. This whole rear face is covered with small brass terminal connectors having binding screws to facilitate the changing of jumpers, the latter being threaded through in each case and being connected on the face of the panel. The switchboard line cables are 52-pair interior cables, and start from the inside of the rear face of the cross-connecting board, thence passing down under the false floor and across to the right-hand side in the picture, where the front of the switchboard cable chute is located, but not shown. Each cable has its terminal wires formed up and threaded through one side of the panels to the connectors. Across the front of the distributing cage, and with about 4 ft. intervening, is the power switchboard. It is shown with temporary wooden panels before the slate panels had been received. The only available source of electrical supply at the time was a 500-volt direct-current circuit. A 5-hp 500-volt Crocker-Wheeler motor has been installed, belted to a counter shaft hung on the under side of a heavy wooden platform which carried all the machines. From this the two charging machines are driven, either being capable of running independently, of course. A reserve motor has been added, pending the completion of 110-volt lighting mains by the local electric light company. In addition to this set of machines a water motor is provided in the basement with a ringing generator connected to it and wired to the power switchboard for use in case of failure of the 500-volt current, the storage cells having capacity to tide over any ordinary interruption. These are chloride batteries of 500 ampere-hours capacity, arranged in duplicate on shelves, protected by a casing with glass doors. Twenty-six cells are employed in each set, the voltage of the signalling current on the lines being about 32, sixteen cells being thus required for this service, and the others furnishing current for the operators' transmitters, local switchboard circuits and the lamp signals.

Most of the subscribers during the past year have been served through underground cables. All of the main cables are 120-pair, lead sheathed and paper insulated, of Roebling make. The conduits are of terra cotta, in four-duct and six-duct units; the main trunk conduits have sufficient capacity for over 4000 lines. The distributing poles are of locust, averaging 50 ft. in height, and provided with square platforms strongly framed with iron, and wooden terminal boxes containing double rows of terminal strips with protective devices. Wherever practicable within the city, conduits were run and the cables taken directly into the basements of buildings to be served. distribution being then effected by means of small terminal boards and interior cables. At the exchange all cables enter through the front foundation walls, passing into a cable vault. Thence a vertical brick shaft passes up to the second floor, into a large room over the main entrance, where the distributing and cross-connecting boards are located. This cable shaft is located about 20 ft. back from the front wall, and between it and the latter is a second vertical shaft which carries the switchboard line cables up to the third floor, where they pass directly to the wall brackets in Fig. 2 over the top of the switchboard.

## Elements of Illumination—XVIII.

By Dr. Louis Bell.

IT is not desirable or economical to operate an incandescent lamp too long, since not only does it decrease greatly in efficiency, but the actual light is so dimmed that the service becomes poor. If the lighting of a room is planned for the use of 16-cp lamps, and they are used until the candle-power falls to, say, 10, which would be in about 600 hours in an ordinary 3-watt per candle lamp, the resulting illumination would be altogether unsatisfactory. Quite aside from any consideration of efficiency, therefore, it becomes desirable to throw away lamps of which the candle-power has fallen below a certain point.

Much of the skill in modern lamp manufacture is directed to securing the best possible balance between efficiency and useful life, a thing requiring the best efforts of the manufacturer. Fig. 1 shows graphically the relation between life, candle-power and watts per candle derived from tests of high-grade foreign lamps. In comparing these, like the previous data, with American results, it should be borne in mind that these foreign tests are made, not in terms of the English standard candle, but generally in terms of the Hefner Alteneck standard, which is somewhat (approximately 10 per cent) smaller.

These curves show the results from lamps having an initial efficiency of 2.5, 3.0 and 3.5 watts per candle-power and an initial candle-power of 16. They show plainly the effect of increased temperature on the life of the lamp and it is unpleasantly evident that in the

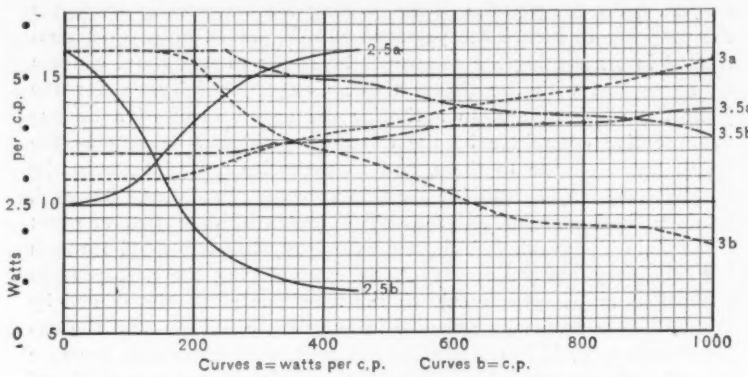



FIG. 1.—CURVES SHOWING LIFE, CANDLE-POWER AND WATTS PER CANDLE.

neighborhood of 3 watts per candle a point is reached at which a further increase of efficiency produces a disastrous result upon the life. In other words, that efficiency represents a temperature at which the carbon filament rapidly breaks down. And so long as carbon is used as the radiant material there is a strong probability that there can be no very radical improvement in efficiency. Of course, if incandescent lamps were greatly cheapened, it would pay to burn them at a higher efficiency and replace them oftener. It is quite possible that increased experience and persistent efforts at standardization would lead to this result. In manufacture on a large scale the mere manufacture of the lamps can be done very cheaply, probably at a cost not exceeding 7 to 8 cents, but the cost of proper sorting and testing to turn out a uniform high-grade lamp, and the incidental losses from breakage and in lamps of odd and unsalable voltages raises the total cost of production very materially. Much of the reduction in the price of incandescent lamps in the past few years has resulted from better conditions in these latter respects, as well as from the improved methods of manufacture.

And it should be pointed out that the difference between good and bad lamps, as practically found upon the market, lies mostly in their different rates of decay of light and efficiency. It is the practice of many of the large lighting companies who renew the lamps for which they furnish current to reject and replace lamps which have fallen to about 80 per cent of their initial power. First-class modern lamps worked in the vicinity of 3 watts per candle-power will hold up for 400 to 450 hours before falling below this limit, and at 3.5 or 3.6 watts per candle-power, will endure nearly double that time. They are often rated in candle-hours of effective life and on the showing just noted the recent high efficiency lamp will give a useful life of 6000 to 7000 candle-hours, with an average efficiency of perhaps 3.25 watts per candle. A medium grade lamp of similar nominal efficiency may not show more than 250 or 300 hours of effective life with a similar consumption of energy—say 4000 to 4500 candle-hours. The economics of the matter appear as follows: The first lamp during its useful life of, say, 6500 hours, will consume 21,125 kilowatt-hours, costing at, say 15 cents per kilowatt-hour, $3.17, and adding the lamp at 18 cents, the total cost is $3.35, or 0.0515 cent per candle-hour, while the poorer lamp at 4000 candle-hours will use $1.95 worth of energy, and at 18 cents for the lamp, would cost 0.0532 cent per candle-hour. To bring the two lamps to equality of total cost, irrespective of the labor of renewals, the poorer one would have to be purchased at 11 cents. In other words, poor lamps generally so increase the cost of renewals that it does not pay to use them at any price at which they can be purchased under ordinary circumstances.

As has already been explained, lamps deteriorate very rapidly if exposed to abnormal voltage, and the higher the temperature at which the lamp is normally worked the more deadly is the effect on increased voltage. It thus happens that if high efficiency lamps are to be used, very good regulation is necessary. Occasional exposure to a 5 per cent increase of voltage may easily halve the useful life of a lamp, while, of course, permanent working at such an increase would play still more havoc with the life, cutting it down to 20 per cent or less of the normal. Good regulation is therefore of very great importance in incandescent lighting, not only to save the lamps and improve the service, but to render feasible the use of high efficiency lamps. On the whole, the best average results seem to be obtained in working lamps at 3 to 3.5 watts per candle. Those of higher efficiency fail so rapidly that it only pays to use them when energy is very expensive and must be economized to the utmost. The 2.5-watt lamp of Fig. 1, for example, has an effective life of not more than 150 hours, at an average efficiency of about 2.75 watts per candle. A 2-watt lamp will fall to 80 per cent of its original power in not far from 30 hours at an average efficiency of about 2.25 watts, while if started as a 1.5-watt lamp, a few hours reduces the lamp to practical uselessness.

There is seldom any occasion to use lamps requiring more than 3.5 watts per candle-power, save in case of very high voltage installations where the saving in cost of distribution may offset the cost of the added energy. The difficulty of making durable 250-volt lamps on account of the extreme thinness of the filament has been already referred to, and it is certainly advisable to use in such installations lamps of 20 candle-power or more whenever possible, thus making it possible to work at better efficiency without increased risk of breakage. Even when power is very cheap there is no object in wasting it, and a little care will generally procure regulation good enough to justify the employment of incandescent lamps of good efficiency. And not only this, but in the commercial use of lamps it is necessary for economy that the product should be uniform. It has already been shown that medium grade lamps are characterized by a shorter useful life than first-class lamps. Unfortunately, there are on the market much worse lamps than those described. It is not difficult to find lamps in quantity that are so poor as to fall to 80 per cent of their initial power in less than 100 hours. A brief computation of the cost of replacement will show that these are dear at any price. Now, if lamps are not carefully sorted, a given lot will contain both good lamps and poor lamps, and will not only show a decreased average value but will contain many individual lamps so bad as to give very poor and uneconomical service. Fig. 2 shows what is sometimes known as a "shotgun diagram," illustrating the variations found in carelessly sorted commercial lamps. In this case the specifications called for 16-cp 3.5-watt per candle-power lamps. The variation allowed was from 14.5 to 17.5 mean horizontal candle-power, and from 53 to 59 total watts, which is a liberal allowance, some companies demanding a decidedly closer adherence to the specified limits.

The area defined by these limits is marked off in the cut forming the central "target." The real measurements of the lamps tested are then plotted on the diagram and the briefest inspection shows the results. In this case only 46 per cent of the lamps hit the specifications. All lamps above the upper slanting line are less than 3.1 watts per candle-power, and hence are likely to give trouble by falling rapidly in brilliancy and breaking early. Lamps below the lower slanting line are over 4 watts per candle-power, hence are undesirably inefficient. Moreover, the initial candle-power of the lot varies from 12.2 candle-power to 20.4 candle-power. Such a lot will necessarily give poorer service and less satisfactory life, and is, as a matter of dollars and cents, worth much less to the user than if the lamps had been properly sorted at the factory. Filaments cannot be made exactly alike, and the manufacturer has to rely upon intelligent sorting to make use of the product. For example, the topmost lamp of Fig. 2 should have been marked for a lower voltage, at which it would have

done well. Nearly all the lot would have properly fallen within commercial specifications for 16-cp lamps at some practicable voltage and rating in watts per candle-power. The imperfect sorting has misplaced many of the lamps and depreciated the whole lot.

In commercial practice lamps should be carefully sorted to meet the required specifications, and the persons who buy lamps should insist upon rigid adherence to the specifications and should, in buying large quantities, test them to ensure their correctness. To sum up, it pays to use good lamps of as high efficiency as is compatible with proper life, and to see that one gets them.

The real efficiency of an incandescent lamp, *i. e.*, the proportion of the total energy supplied which appears as visible luminous energy, is very small, ordinarily from 5 to 6 per cent, not over 6.5 per cent even in a 3-watt per candle-power lamp. This means that in working incandescent lamps from steam-driven plants not over 0.5 per cent of the energy of the coal appears as useful light. This is a sad showing, and one which should spur invention. To get better results, it seems necessary to abandon the carbon filament, at least in any form in which we now know it, and either to turn to some other material for the incandescent body, or to abandon the principle of incandescence altogether and pass to some form of lamp in which the luminosity is

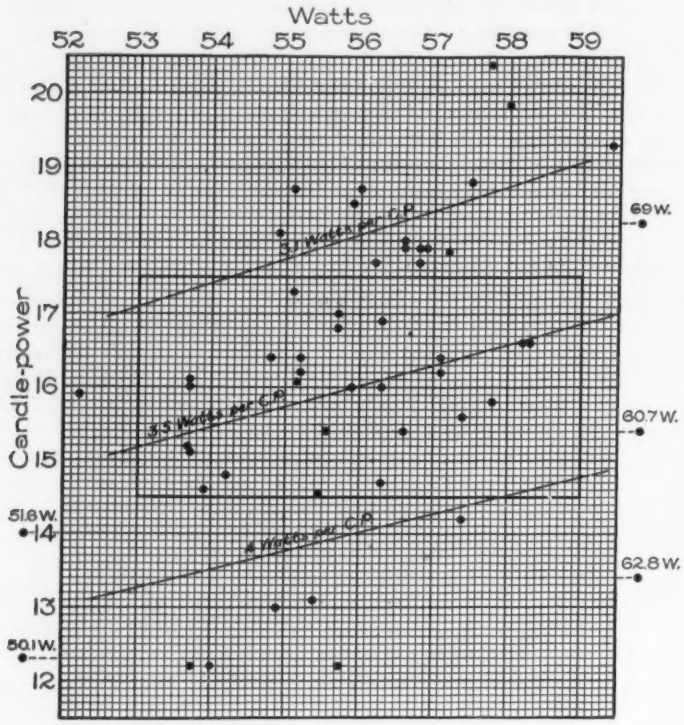



FIG. 2.—"SHOTGUN" DIAGRAM.

not due to the high temperature of a solid radiant. The writer is strongly disposed to think that the ultimate solution lies in the latter alternative, although the former offers hope of very considerable and perhaps revolutionary improvements.

Within the past few years a large number of attempts have been made at preparing a filament for incandescent lamps of some material far more refractory than pure carbon, and hence better able to endure the high temperature necessary for securing high efficiency. A glance at the temperature curve of the last paper shows that a rise of 200 degs. C. or so in the working temperature would produce an efficiency of nearly or quite one candle-power per watt.

These attempts have been of several kinds. One method has been to incorporate refractory material with the carbon in manufacturing the filaments, thus both increasing the resistance of the filament and giving it a proportion of heat-resisting substances. Owing, however, to the fact that such filaments still contain a considerable proportion of carbon which is comparatively easily vaporized, there is good reason to doubt the efficacy of the process. The carbon, which is the cement, as it were, once disintegrated, the filament would give way, and experience up to date has tended to throw doubt on the success of any such scheme.

An interesting modification of this method is that proposed by Langhans, who forms filaments of carbide of silicon, *i. e.*, employs carbon in chemical combination instead of merely as a species of cement. This process has not been carried to commercial success, but it certainly looks more hopeful than the process of incorporation on general principles.

Another line of attack on the problem is that of Auer von Welsbach, who proposed a filament of platinum or the allied metals, coated with thoria, the rare earth which is the chief constituent of the Welsbach mantle. This looks mechanically dubious. Still another modification of this idea is the use of a filament mainly of carbon, but with a coherent coating of thoria or the like, a line of investigation which appears worth pursuing. Akin to this is the Nernst lamp, which is at present exciting great interest, although it is not yet in the commercial stage. The basic fact on which Dr. Nernst's work is founded is that many substances, non-conductors at ordinary temperatures, become fairly good conductors when heated. Thus a tiny pencil of lime, magnesia or the rare earths, when once heated, will allow a current to pass at commercial voltages sufficient to maintain it at vivid incandescence. From this fundamental fact Nernst has developed a most interesting and promising glow lamp.

## Important Developments in Erie Telephone.

It is stated that the stockholders of the Erie Telegraph & Telephone Company did not subscribe largely for the new issue of stock offered in December for extension work, etc. The company has therefore had to look elsewhere for funds. A special meeting of the Erie Telegraph & Telephone Company was held in New York on Jan. 9 for the purpose of authorizing the directors to mortgage the property to secure the payment of obligations, or of debt contracted in transacting the company's business; to ratify and confirm an agreement with the Postal Cable Company, of Texas, for the joint use of lines, and to authorize the appointment of a finance or executive committee by the directors with such powers as the board may delegate to them, and to authorize amendments to the by-laws that may be suitable for this purpose. President Charles J. Glidden, in a circular letter to stockholders of date Jan. 2, says: "The Erie Telegraph & Telephone Company has expended through its subsidiary companies very large sums during the past year in extensions and improvements of the telephone properties owned by them. These properties are now in excellent condition, and the expenditures will, it is confidently expected, very materially increase the earning capacity of the several companies, and consequently of the Erie Telegraph & Telephone Company. The expenditures could not be made, however, without raising large sums of money, and the Erie Company has been obliged to incur debts amounting to about $6,000,000, including those of the subsidiary companies, which it is now desired to provide for, which debts are represented by notes falling due from time to time during the coming eight months. It is proposed eventually to provide for this indebtedness in permanent form, either by the issue of additional stock or by bonds running for a term of years, or both. At the present time, however, the company has an opportunity to make a very satisfactory agreement with the Old Colony Trust Company and its associates, whereby there will be raised a sufficient sum to pay and take care of the company's notes and to provide not exceeding $1,000,000 for further needed extensions and improvements in the telephone properties during the coming year."

The amount raised is said to be $7,500,000, coming from bankers understood to be identified with American (Bell) Telephone & Telegraph interests. Twenty per cent. of the sum is to be forthcoming Jan. 10. The stock went off to 82, a loss of 15 points, on the announcement, which carries with it an implication that the Telegraph, Telephone & Cable Company of America, representing "independents," and which is said to have bought it in at about 115, had lost its control of Erie.

The Erie Telephone system made a net gain of 2,278 subscribers in December; 35,041 for the year. Total connected, Dec. 31, 141,599; waiting connection, 2,924. As to how and where the Erie Telephone Company could use $6,000,000 in one year, "the question is easily answered," said a prominent telephone man last week. "Over 35,000 new subscribers were added to the Erie system in 1900. This would cost alone about $4,500,000, and the balance could be wisely invested in exchange buildings and long-distance lines. Erie's gross earnings, it is said, increased over $1,000,000 in the ten months ending Oct. 31, and the net exceeds 8 per cent. on the cost of all improvements."

## Electrical Plant of the Manhattan Elevated Railway—II.

*(Concluded.)*

SIDE and end views of the alternator are shown in Figs. 11 and 12, and its construction is illustrated in outline in Figs. 14 and 15. The field magnets are built up as an integral part of the flywheel to which they, with their windings, form the rim, as will be seen by reference to Figs. 13 and 14. The construction consists of a steel hub to which are bolted and dovetailed annular-rolled steel web plates, which form the driving spider. The field poles and rim are built up of overlapping plates of thin sheet steel, the length of each plate being equal to the width of two poles. These plates are dovetailed into the driving spider and the rim and poles with their steel end plates are separately bolted together. In the body of the field poles at intervals of about 3 ins., ventilating spaces or ducts are provided, these spaces extending inward through the laminated steel rim of the flywheel to large openings in the cast-iron driving rim. The ventilating ducts in the revolving field register with corresponding ducts in the external stationary armature. (See Fig. 13.)

The field winding consists of copper strap wound on edge, one layer deep, with insulating material cemented in place between the turns, the edges of the strap being exposed. No supporting shell for the coil is used, and the entire outer insulation, which separates the coil from the pole, can be removed and renewed without injuring the coil. The heat-dissipating surface of the coils is either close to the metal field pole, to which it may readily impart its heat by conduction, or is exposed to free air circulation, thus insuring a low temperature even under abnormal conditions of operation. An important feature of the construction of the field is the use of copper wedges having large external lips which overhang the beveled edges of the field poles. These wedges assist in keeping the field poles in place, and the overhanging lips, which come directly between the fields, act powerfully to retard any shifting of the field magnetism across the pole faces, thus tending to prevent and correct any variation of the angular velocity. Fig. 13 illustrates the construction of the field poles and shows the field windings in place and also the copper wedges above referred to.

The armature, which is stationary and exterior to the field, consists of a laminated ring with slots on its inner face, the insulated copper bars constituting the armature winding being placed in these slots. The winding is of the built-up or bar type, the bars being separately insulated and placed in partially closed slots in the armature core.

There will be three bars per slot, and the winding is grouped in such a manner that end connectors having high differences of potential will not lie close together. In case of an accident causing damage to the insulation, the contents of any slot may be removed without disturbing the other slots and without moving the frame of the machine.

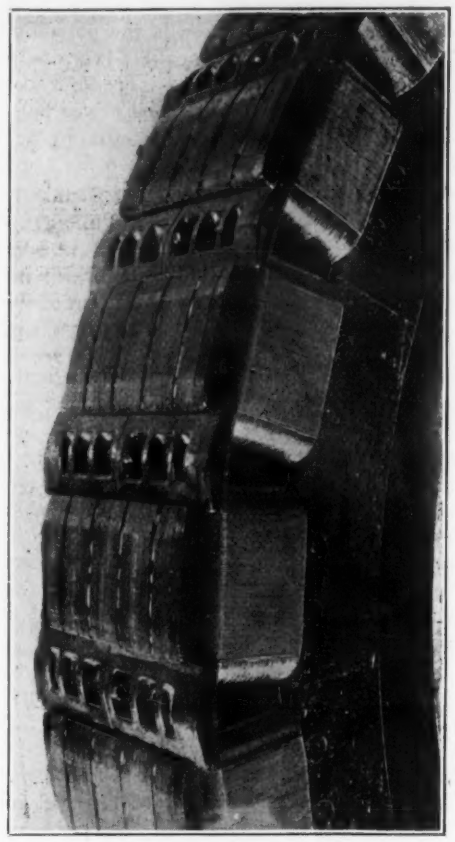
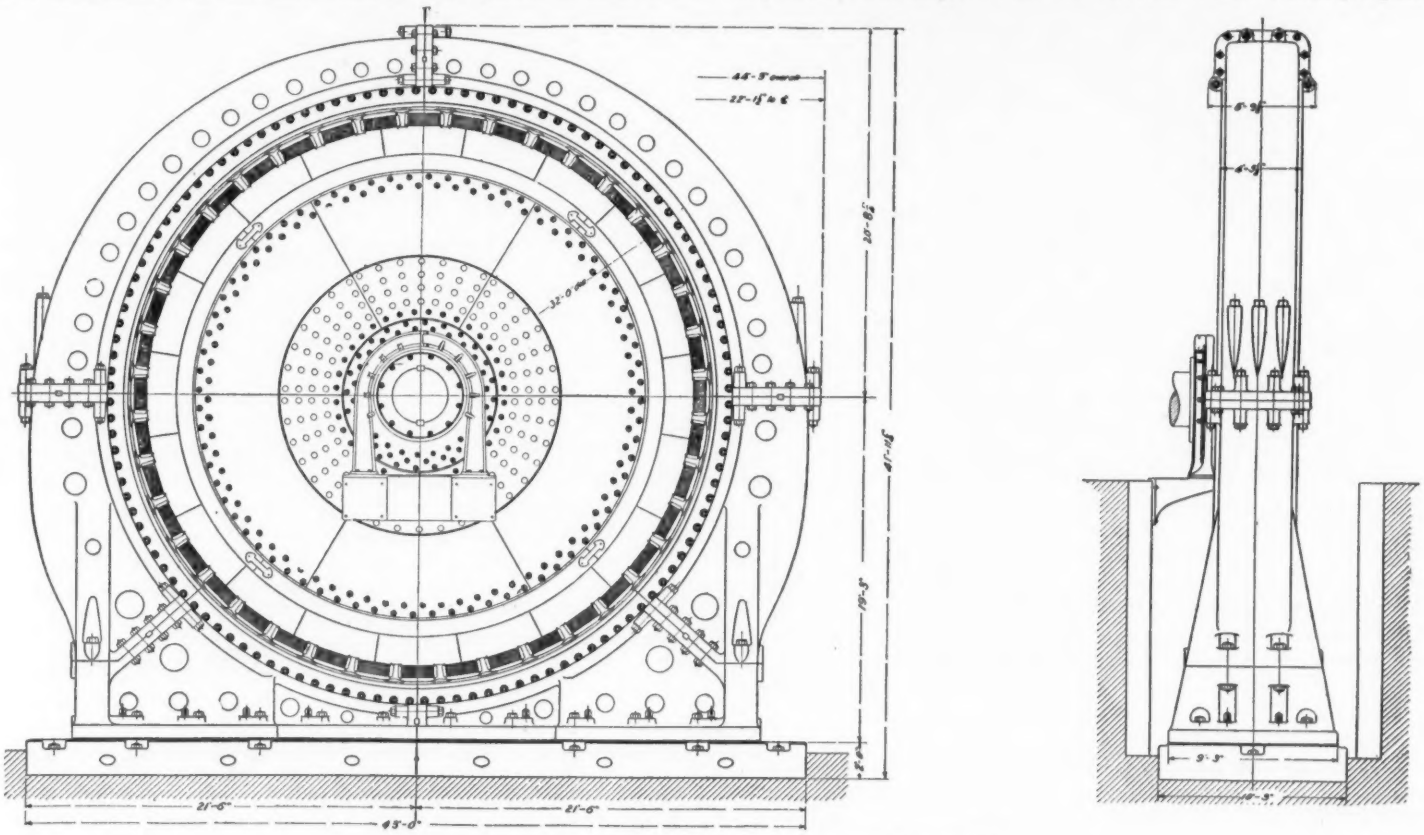


FIG. 13.—SHOWING CONSTRUCTION OF FIELD POLES AND WIRING.

The insulation of the field coils is to stand a pressure test of 2500 volts alternating potential for a period of one minute, and that of the armature conductors a puncture test of 25,000 volts alternating potential for a period of 30 minutes, or 30,000 volts for one minute, or 35,000 volts for one second.

The field pole tips are bevelled at the edges to produce a magnetic field distribution of such a form that, with a star type of three-phase winding the e. m. f. wave will be practically a sine wave at no load. The field produced by cross-magnetism with load, and magnetic leak along the conductors, will be of such form that the e. m. f. produced thereby in the armature windings will also be practically sine shaped, thus producing a full load wave necessarily very closely sine shaped. There will be four armature slots per phase per pole, thus securing a distribution of the coil which should produce a wave practically free from irregularities and of the same form within close limits for different loads. By this means harmonics, which are apt to occur with windings in which there are but few



FIGS. 11 AND 12.—SIDE AND END VIEWS OF THE ALTERNATOR.

slots per phase, are avoided, together with possible evil effects in connection with the capacity and induction of the very extensive system of cables and transmitting apparatus to which the alternators are to be connected. Another advantage obtained by the use of a large number of partially closed slots in the armature core is the possibility of using copper dampers for the pole tips with neglible loss due to eddy currents.

The speed of the alternators is 75 r. p. m., and as there are 40 poles, this corresponds to a frequency of 25 p. p. s. Each alternating field will require approximately 225 amperes at 200 volts when the armature is delivering its full rated current at 11,000 volts on a non-inductive load. About 15 per cent more current will be required when the armature delivers its full rated output at normal voltage to a circuit having a power factor of 90 per cent. As to regulation, the manufacturer guarantees that if a load of 263 amperes per terminal at 11,000 volts, and with 100 per cent power factor, be thrown off, the potential will rise no more than 6 per cent with constant speed and constant field excitation. It is calculated that under non-inductive load each alternator will have an efficiency ranging from 90 per cent at quarter load to 96.5 at full load and 97 per cent at 25 per cent over load, mechanical friction not being included. Under non-inductive load, the alternators will operate for 24 hours delivering their normal rated output with a rise in temperature in no part of the machine exceeding 35 degs. C above the surrounding air, and not exceeding 45 degs. C when operating at 25 per cent greater than the normal full load. With a current for two hours, 50 per cent greater than normal, the rise in temperature will not exceed 55 degs. C. The above statements are based on non-inductive load.

There will be seven sub-stations, of which three will supply the West Side lines, being located, respectively, on Canal Street, Fifty-third Street, near Ninth Avenue, and at 110th Street. The East Side lines will be supplied from four sub-stations located, respectively, at the corner of Division Street and Allen Street, Thirty-fourth Street, near Second Avenue, Ninety-eighth Street, near Third Avenue, and Third Avenue, near 161st Street, in the Borough of the Bronx. All of the sub-stations are adjacent to the lines of the elevated road, except the Canal Street station, which is between the Sixth and Ninth Avenue lines.

Each sub-station has three floors. In five of the stations the two upper floors contain space for storage batteries, in two others corresponding space being provided in the basement. The space thus reserved will in each case accommodate a battery of 3,000 kw hours, but it is not expected to use storage batteries at the start. Fig. 15 gives a floor plan of the lower floor, from which it will be seen that rotary converters are arranged in two parallel rows, the tops of their foundations being at the level of the main floor of the sub-station. The transformers are located in groups of three, placed upon galleries which extend along the side of the sub-station at a height of about 15 ft. above the main floor, and in close proximity to the converters they serve. Cranes are provided for handling these transformers. The switching apparatus for the sub-station is erected upon galleries at one end of the building.

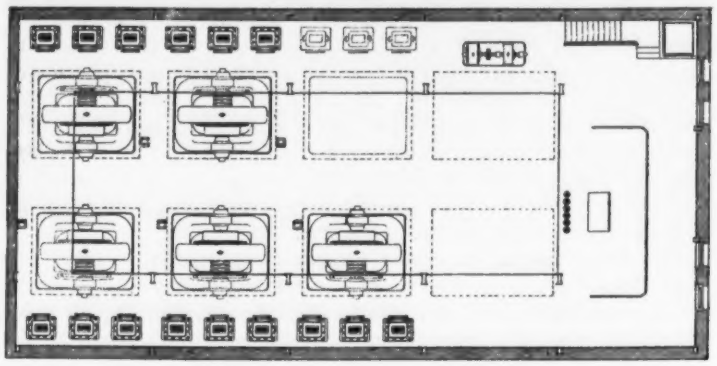
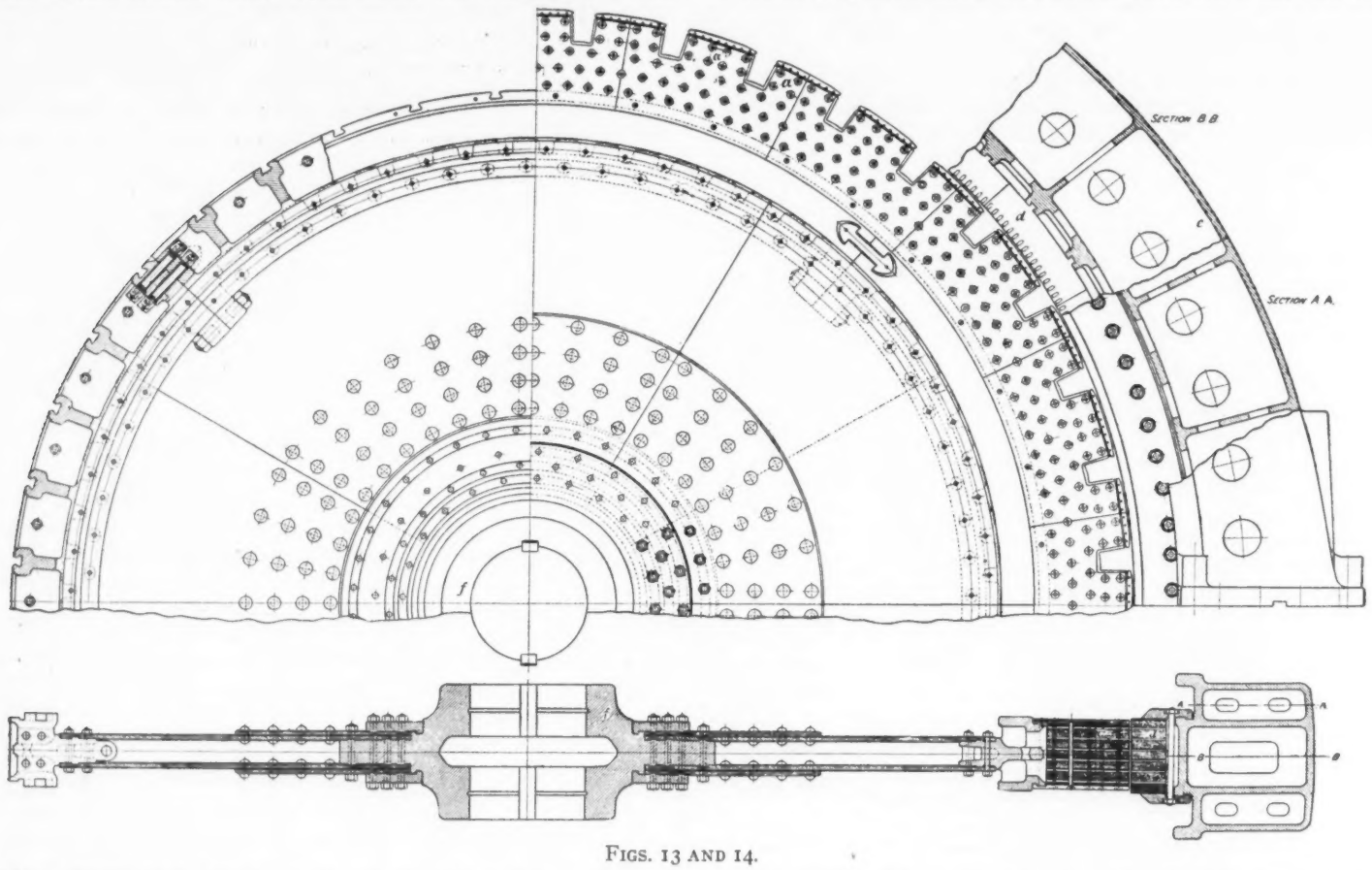


FIG. 15.—PLAN OF LOWER FLOOR.

Each rotary converter receives current from a group of three step-down transformers connected in delta. For each converter six 1,250,000-circ. mil. cables are required. In order that the potential of direct current delivered by all rotary converters shall be equal, provision for adjustment of the ratio of transformation of the step-down transformers is made by means of loops brought out from primary windings.

The transformers, whose positions are shown in Fig. 15, are of the air-cooled type, motor-driven blowers being installed in each sub-station for supplying the necessary air. The guaranteed efficiencies range from 95 per cent. at one-quarter load to 97.75 per cent. at full load and 97.7 per cent at 25 per cent over-load. For the latter load the rise in temperature will not exceed 45 deg. in twenty-four hours.




FIGS. 13 AND 14.

The rotary converters are of the largest capacity yet constructed. Each has a normal rating of 1500 kilowatts and is capable of delivering, for a period of several hours, 2250 kilowatts. They have 12 poles, which corresponds to a speed of 250 r. p. m. and 25 p. p. s. The field

has shunt and series windings, the former being arranged for self-excitation. The guaranteed efficiencies vary from 89 per cent at quarter load to 95.75 per cent at full load and 96 per cent at 25 per cent overload.

The armature winding consists of strap and form-wound coils, insulated before being placed in the slots, in which they are held by retaining wedges of hard fibre—no armature bands being used. The insulation is guaranteed to withstand a puncture test of 3500 volts alternating applied between conductor and core for a period of one minute. As previously stated, alternating current will be delivered at 390 volts and direct current taken from the commutator at 625 volts.

The winding is of the parallel type, comprising 12 circuits. There are a large number of cross-acting balancing rings to obtain equalization of the different armature circuits. The difference of potential between adjacent bars of the commutator will not exceed 12 volts. The pole faces of the field, which are beveled at the edges, are fitted with copper shields consisting of heavy copper rings about the pole tips, having lips extending from both edges of the pole toward the centre. The action of these lips is to retard, by means of secondary currents induced in them, any shifting of magnetic field across the pole face, which shifting, if not counteracted, would give rise to "pumping" of the converters. The ring around the pole acts as a secondary and neutralizes any pulsation of the entire field magnetism. The rotary converters are designed not only to steady themselves, but at the same time to produce a steadying effect upon the apparatus on the system.

The shunt field winding will have sufficient capacity for maintaining 625 volts at the direct-current terminals at full load, with a power factor of 100 per cent at the alternating current end. A shunt field rheostat will be provided of sufficient capacity to reduce the potential to 575 volts. In normal operation at full load the shunt field will be adjusted for the lower strength, the armature taking the current from the system. The series field will be designed to add to the shunt as the load goes on the rotary converter, and will be sufficient to compound from 575 volts no-load to 625 volts full-load with no ohmic drop in the alternating current feeder. Suitable inductances will be placed in each feeder circuit.

The converters are to be started by direct current, a motor generator system being installed in each sub-station for this purpose. This method of starting rather than by the use of direct current from the main bus-bars of the sub-station was adopted for the purpose of avoiding undue magnetic and electrical strains in the converter, such as might result from the mistake of an operator, for example, in closing the synchronizing switches when the machines are not exactly in step. The total weight of each converter is, approximately, 22.5 tons.

### SWITCHING APPARATUS.

The switching devices used in the Manhattan plant embody material improvements upon previous types, and its organization formed one of the most important problems in the design of the plant. The switching apparatus is largely automatic, and interlocking or equivalent means are adopted where sequence in throwing switches is essential. In every way the designers have kept in view the necessity of manipulating the switchboard devices with the utmost possible degree of promptness and accuracy. As in the case of the new plant at Niagara Falls, the switching apparatus will be operated by means of a controlling board so arranged as to present to the eye of the operator at all times an accurate diagram of the more important connections of the alternators, bus-bars and feeder circuits.

In the organization of the switching apparatus great care is taken in order that any failure of a cable, a switch or other device shall not result in a general interruption of service. Among the special provisions to procure this result are the following:

Each of the high-tension cables is equipped at the power-house end with an oil circuit-breaking switch, with a time limit relay device which may be so adjusted that in case of a short circuit in the cable the supply of current shall be interrupted at the end of a fixed interval, say three seconds. At the sub-station end the cable is connected to the bus-bars through a similar oil circuit-breaking switch, but in this case the automatic device is arranged to open the switch in the case of a reversal of the current such as would be caused by a short circuit in the cable. This reversed current relay will be adjusted to act instantly and thus any cable which may become short circuited will be instantly cut off automatically from the sub-station apparatus, and at the end of three seconds will also be automatically disconnected from the power house.

In case the feeder switch fails to open the circuit, when operated automatically or by an attendant, the group switch in series with it may be opened. While this will result in temporary cessation of supply to one of the sub-stations, trains will still be able to operate at somewhat reduced speed until the supply of power to the sub-station affected is restored similarly. If one of the two switches, which in service are connected in series between each alternator and the bus-bars, should fail to open, the other may be used.

In each high potential alternating current circuit which connects the bus-bars at the sub-stations with a group of step-down transformers, and through them with a rotary converter, an automatic circuit-breaking oil switch with time limit relay will be placed; and in the direct-current circuit between the converter and direct-current bus-bars, the circuit breaker will be arranged to open the circuit when power exceeding a certain predetermined small amount, does not flow back through the direct-current bus-bars into the converter. In case of a short circuit in the group of transformers, or in the converter, or in the connecting circuits between the alternating current circuit breaker and the direct-current circuit breaker, these breakers are intended to act automatically and disconnect from the alternating current bus-bars and from the direct-current bus-bar, the converter unit affected.

The Manhattan switching apparatus will be controlled electrically and without the intervention of compressed air, the large switches being operated by means of electric motors working in conjunction with powerful springs. The motors, and consequently the switches, are in turn controlled by electric circuits which pass through small switches immediately under the hand of the operator, these switches being assembled upon a bench-board where they are arranged in conjunction with dummy bus-bars and connections so as to place at all times before the eye of the operator an accurate diagrammatic representation of the existing connection of the alternators for the switches, bus-bars and converters.

Two complete sets of bus-bars are used, to which any alternator or any feeder may be connected. The eight alternators to be installed immediately will be divided into two batteries of four each; thus there will be two sections of bus-bars, and two duplicate sets of bus-bars in each section.

The main bus-bars are not divided into generator and feeder sections, but feeders will be tapped off at the same point where generators are tapped in. As a result of this, the bus-bars will be traversed normally by only a small portion of the total current delivered from the plant, the larger part of this current flowing directly from alternator switches to group switches, the bus-bars thus to some extent serving as equalizers.

The high-potential oil-break switches, which, together with the entire switching apparatus, will be supplied by the General Electric Company, are of such a form that each phase of the circuit is isolated from the other phases in a special enclosed brick compartment, each compartment containing two enclosed brass vessels partially filled with oil, below the surface of which the circuit is broken. As stated before, the quick opening and closing of the switch is obtained by means of powerful springs, the mechanism being such that a motor not only serves to close up the springs ready for the next operation, but also serves as a tripping device, allowing the springs to operate as soon as the motor is started. All of the motors operating the oil switches will be supplied with power from the 110-volt storage battery mentioned in the description of the power house.

The alternating current switching devices in each of the sub-stations will resemble, in general those in the power house, but there will be no duplicate bus-bars. Each station will have a single set of bus-bars placed in isolated brick compartments with incoming feeder switches to one side of the bus-bars and out-going rotary converter switches to the other side. The bus-bars will be divided by knife switches into sections, one for each rotary converter, in order to make it possible to shut down any section of the bus-bars for repairs. The sub-station switchboard will be supplemented by a controlling bench-board.

In the arrangement adopted for switch control, the advantages of the 'closed circuit principle" are retained without its disadvantages. The term "closed circuit principle" signifies connections such that when the supply of direct current used for operating the switches fails, all switches open, the controlling current being used to close the switches and some opposing force, for example, gravity, to open them. The advantage of this principle, which is much used in railway work, lies in the fact that any failure of the controlling circuits is at once manifested and may be corrected, and there is, therefore,

no danger that the system of control will fail to operate at the time when the operator attempts to use it.

Obviously, the disadvantage of the closed circuit principle is that any momentary failure of the supply to direct current used for the controlling circuits results in opening all of the alternating current switches in the power house, and so interruping the entire service. In the Manhattan arrangement, indicating devices of the visual signal type, resembling those in use on the modern common battery telephone switchboard, are introduced which obviate the disadvantage referred to. These indicating devices will be bulls-eyes, illuminated by small incandescent lamps, which will be supplied with current over the operating wires from the oil switches and by a circuit completed through the motor of the oil switch, so that the lamps are at all times a guarantee of the integrity of the circuit. Two of these lamps will be used for each oil switch, one to indicate that it is closed, and the other to indicate that it is open. The lamps thus serve as a check on each other in case of the failure of the filament or any broken connection in the lamp circuit.

The alternator controlling bench board is illustrated diagrammatically in Fig. 16. On the upper or rear part of the board the duplicate bus-bars are represented by two strips of oxidized copper. They are divided by bus-junction switches into two sections, to each of which four alternators are connected. In the diagram, the row of "rectangular synchronizing receptacles" serve also to represent the alternators. The connections of alternators, switches, bus-bars and bus-junction switches are diagrammatically represented on the alternator controlling bench board, while the group switches and the feeder switches are similarly represented on the alternating-current feeder controlling bench board in Fig. 17. Referring to the former, it will be noted that for each alternator there are three oil switches, one at all times in series with the alternator, the other two connecting the alternator respectively to the two sets of duplicate bus-bars; thus there are always two switches in series with each

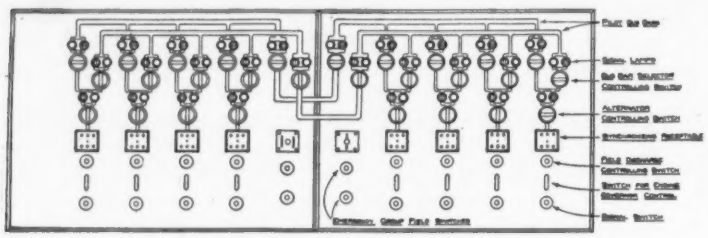


FIG. 16.--ALTERNATOR CONTROLLING BENCH BOARD.

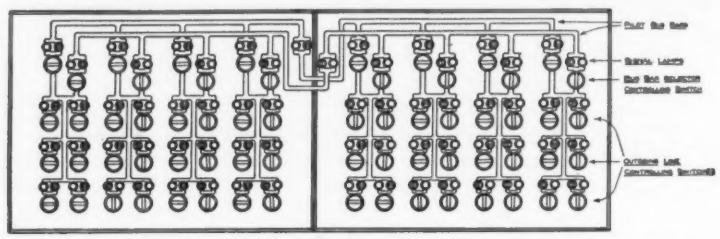


FIG. 17.--ALTERNATING-CURRENT FEEDER CONTROLLING BENCH BOARD.

other between each alternator and either set of bus-bars, affording opportunity to test the operation of any oil switch at any time when the corresponding alternator is not in service.

The controlling switches on the bench board will have horizontal swing handles, which in their up and down position on the board open the main oil switches, while in a cross position on the board they open the main switches. For simplicity, the diagram represents only one conductor of each circuit, the diagrammatic conductor, consisting of strips of oxidized copper, the handles of the controlling switches and opaque strips in the little round glass windows immediately over the signal lamps. The pilot diagram of circuits on the bench board is so run that the switch handles apparently open and close the diagrammatic circuit. The opening and closing of these small controlling switches, of course, does actually open and close the oil switches, and therefore the actual position of the oil switches is at all times indicated by the position of the controlling switches in the diagram.

The lamps will be similarly arranged. The two bulls-eyes for each switch will be of different colors, red to indicate that the switch is closed, and green to indicate that it is open. Opaque strips closing the pilot diagram of circuits under the red bulls-eyes and opening the pilot diagram of circuits under the green bulls-eyes will also be used to apparently complete the diagrammatic circuit connection, the operator having immediately before him at all times an exact representation of the actual connections of the alternating-current circuits, and not having to trust to memory to determine what alternators are connected to one or the other set of bus-bars, nor what bus-bars are connected to each other. A glance at the controlling board for the feeder circuits similarly will show him how the several groups of feeders are connected to the bus-bars.

Referring again to the view of the alternator-controlling bench board, there will be seen below each main alternator switch a six-point synchronizing receptacle, which serves also the purpose of representing the alternators in the diagram. Two synchronizing voltmeters will be used, one at the rear of each panel of the alternator-controlling board. These will be connected on a new principle, synchronizing neither bright nor dark, but at the middle of the voltmeter scale. This plan has several advantages, showing the slip or angular displacement more accurately, indicating the instant of proper synchronism with greater accuracy, and also indicating whether the alternator to be synchronized is running too rapidly or too slowly.

Immediately below the synchronizing receptacle is the field discharge controlling switch, used for tripping an electrically operated field discharge switch on the exciter board. As the tripping of this switch unintentionally while the alternator is in operation might interrupt the service, the controlling switch will be what might be termed a "pull button," which must be pulled up from the face of the board in order to operate the trip. This form is used to avoid danger that the switch might be accidentally manipulated.

Below the field discharge pull button on the alternator controlling bench board will be located a motor governor controller for adjusting the governors of the main engines and equalizing the division of the load between alternators. Below the motor governor controller will be a signal switch, connecting to signal lamps, or gongs, on the starting platform of the corresponding engine. The alternator controlling bench board will also carry a system of emergency field discharge bus-bars, four in number, corresponding to the four duplicate sections of main alternating-current bus-bars. The alternating selector controlling switches will make contact between the field discharge circuits and the emergency discharge bus-bars, thus completing controlling circuits by means of which the fields of all main alternators operated in mulitple may be simultaneously discharged by pulling the emergency pull button. The bus-junction controlling switches will be provided with contacts for uniting the emergency field discharge busses, so that under any circumstances all alternators operating in parallel will have their fields simultaneously discharged by the pulling of a single pull-button switch.

Refering to the alternating-current feeder controlling bench board (Fig. 16), it will be noted that each group of six feeder switches may receive current from either set of bus-bars through a group switch.

In the bench board, as on the switchboard galleries, provision is made for six alternating-current feeders in each group. Not all of these feeders will be required at present, but in a plant of this character it is very important to provide for possible additions and extensions.

Two bench boards will be located side by side, the alternator bench board being placed directly in front of that part of the instrument board which carries the instruments belonging to the alternator panels, while the feeder controlling bench board occupies a corresponding position in front of that part of the instrument board which carries the alternating-current feeder instruments.

Immediately behind the controlling bench boards will be the instrument board, 28 ft. in length, containing all indicating instruments for alternators and feeders.

The instruments for two alternators are combined upon one panel, the instruments for each alternator being mounted in a vertical row. At the top are three ammeters, combined in one case. Below these are placed a voltmeter, an indicating wattmeter, with a scale reading up to 10,000 kw., and a power factor indicator. By means of the relative readings of the last named instrument, the operator will be enabled to accurately adjust the relative field excitation of the various alternators, thus minimizing the magnetizing cross-currents between the alternators.

The power factor indicators will also serve as an automatic signaling device between sub-stations and the power house. The voltage of the whole system will, of course, be determined by the sub-station

requirements. If the voltage delivered by alternators at the power house is too low, sub-station attendants will attempt to raise it by cutting out the field resistance of the rotary converters, and thereby drawing leading currents from the power house. This will be shown upon the power factor indicators of the alternators, whereupon the operator at the power house will raise his voltage to meet the sub-station's requirements, restoring the power factor to unity. The reverse sequence of operation will occur when the direct-current voltage is too high.

## Train Lighting in Germany.

The Electrotechnical Association, under the presidency of Secretary of State Von Podbielski, heard at a recent meeting in Berlin a report of Engineer Doctor Buttner upon the "Electric Lighting of Railway Carriages," followed by a discussion. The reporter naturally referred to the Offenbach railroad disaster and the demand in the daily press that the dangerous oil gas should be replaced by electric light. He said it was remarkable that Germany, otherwise so forward in electricity, had developed next to nothing of this form of lighting. Since the Swiss railway administration began in 1888 on the Simplon Railway with electric lighting, the Swedish, English, French and Danish had followed, so that one encounters in foreign travel much electric lighting of railway carriages. The Paris Exposition had also demonstrated that the electric lighting of railway carriages had made rapid strides in the last decade and had become a formidable competitor of gas lighting. The Prussian railway lines would have perhaps already busied themselves about the installation of electric lighting had not the method of lighting with acetylene gas, or by the system of Julius Pintsch of a mixture of acetylene with oil gas, meantime been adopted.

With electric lighting, about 8000 carriages have been equipped, as against about 75000 carriages and 3000 locomotives with oil gas. Electric lighting is afforded either by means of dynamos, assisted by accumulators, or by these latter alone—and either for the entire train or for each separate carriage. In England, toward the end of the year 1880, it was attempted, without favorable result to utilize the motion of the train to rotate dynamos. In 1886 similar attempts were made on the Frankfurt-Fulda Line, and on the Wurtemburg State Railways. These also failed of adoption. In recent times the following systems were used: 1. The Stone system, extensively used in England, based upon a hanging eccentric dynamo, whose eccentricity is utilized to regulate the pressure. In France the Mediterranean Railway has utilized this system. 2. The Moskowitz system, principally in use in America. 3. A similar system to this called Vicarino. 4. The Dick system, with lighting for each car by means of storage batteries. In Europe this method of lighting is used in the court trains of the Emperors of Russia and of Austria. The court train of the German Emperor uses a mixed system of gas and storage batteries. In Sweden and Denmark the trains are lighted by means of two batteries, one in front and the other at the rear of the train, with couplings between the carriages for conducting the current. Whether this system would be adopted in Germany was doubtful. The Scandinavian system might be strongly opposed by the Imperial railway management because the independence of each carriage is so essential. More advantageous is the installation in each car of one or more batteries, which could be easily handled. Every circuit must possess resistance, resistance regulators and fuses. The charging of the accumulators is easy to arrange. The North-Milan Railway and the Jura Simplon Railway have individual cars with storage batteries—the last named owns 630 cars so equipped. In Austria several railway lines have followed suit, and in Germany nearly all the private lines, as, for example, the Dortmund-Gronau, the East Prussian Southern Railway, etc. The German Post Administration has its carriages all lighted by storage batteries. The postal authorities of Bavaria and Wurtemburg have also adopted this system. Outside of the Continent of Europe electrically lighted railway cars are frequently encountered, recently even in Japan. Dr. Buttner said he might place the number of electrically lighted cars at more than 8000. On account of the ease of turning on and extinguishing the electric light—the former at the instant of need during the trips—it affords a substantial economy, which, for example, in the Dortmund-Gronau line amounts to 50 per cent of the lamp-hours as compared with oil gas, effecting a considerable saving. The objection that storage batteries are too great a weight for the train is erroneous. The speaker had had three years ago the opportunity of proving this to Minister Von Thielen as not tenable, in comparison with the weight of the oil-gas equipment. The cost on the whole, through the economy of lamp attendance should not be considerably increased. The lighting alone costs about 4.3 pfennigs per lamp-hour. The Postal administration reckons the lamp-hour at 3.5 pfennigs. With the cost of installation, amortization, maintenance and current, etc., the cost per lamp-hour should be about 2.55 pfennigs—about the same as the cost per lamp-hour for the oil gas. Certainly the expense is no greater, and this will remove all objections to electric lighting on account of too great cost.

The speaker maintained that the simple accumulator is well suited to German conditions, as shown by the experience of the Postal Department. But while these cars are charged outside, this method is not always suitable for passenger cars, as the batteries require about three hours for charging. A mixed system is recommended, and the charging should be done by changing batteries. Batteries with 20 hours' lighting capacity would be sufficient. The Imperial authorities are using 27 lamp-hour capacity storage batteries. The present stations could be used for electric lighting and the charging of storage batteries. Batteries have also the advantage of being useful for the propulsion of other vehicles. The Prussian Railway Commission has never taken the trouble to arrive at a verdict in regard to electric lighting on the basis of its own experience. At least an experiment upon a small scale could not be cited, such as the equipment of two D-cars on the Berlin-Cologne line with the Stone system. According to the statement of the Prussian Minister, the equipment of the lines with electric lighting would cost 25,000,000 marks. But this amount could be divided among several years, and, contrasted with the extent of the Prussian railway lines, was not great. Above everything, the greatest safety for passengers must form the determining factor. The speaker said he was aware of an official opinion and of the answer published by the Frankfort *Gazette* that the introduction of electric lighting of railway trains would not reduce the dangers of deaths due to fire. At the close of the address he expressed the hope that the Prussian Railway management would make thorough trials with electric lighting and that they would lead to the conviction that 25,000,000 marks would not be too much to expend in order to increase the safety of the traveling public.

Engineer Gerdes spoke in favor of the safety of gas, criticized the methods of electric lighting then in vogue and stated that the question was not yet ready for discussion. This caused Secretary Von Podbielski to remark that the Imperial Postal Service which had, since 1892, used electric lighting, was well pleased with it and had had no disagreeable experiences. Prof. Von Wedding spoke in favor of electric lighting, and especially by storage batteries. He preferred to travel at a speed of 60 to 70 kilometers per hour on top of the battery rather than on gas tanks with a pressure of 6 atmospheres. A speaker who was not wholly a stranger to the Prussian Railway Administration styled gas and mixed gas lighting as harmless. He raised doubts against electric lighting, especially from the technical manager's point of view, and remarked that the cost was too great at present. Mixed gas has three times the illuminating power of oil gas, and can easily, by mixing it with 50 instead of 25 per cent acetylene, have ten times the power. Besides it would not be economical to throw aside the millions invested in excellent mixed gas machines and for 30,000,000 to 40,000,000 more introduce other methods of uncertain value. Herr Von Hefner-Alteneck was of the opinion that German electrical engineering stood on so high a plane that when called upon the engineers surely could produce a good system of lighting. He only regretted that the discussion as to the value of electric lighting on the railways had been connected with the Offenbach disaster, as during thirty years of gas lighting no severe accidents have been reported. But he was confident that if German electrical engineers should have the question presented to them by some large railway management the problem would surely be solved.

## The Development of American Railway Bloc Signaling.

Mr. B. B. Adams, one of the editors of the *Railroad Gazette*, has just concluded in that journal a series of articles on railroad signaling apparatus, and gives some statistics and estimates which are of general interest. He says: "If we deduct the 8,423 miles of four roads we have in the United States 17,480 miles of line; 15,161 miles worked by manual block signals, and 2,319 miles worked by automatic block signals. With the 8,423 miles included, we have just about ten times as much manual as automatic. On the basis of miles of track, however, the proportion would be different, as of the mileage with automatic signals five-sixths is double track or four track,

while of the lines with manual signals three-fourths is single track. Of the road worked by manual signals about 1,000 miles has the 'controlled manual,' more than a third of this being four-track line."

Referring to the cost of block-signal installations, Mr. Adams says: "The Philadelphia & Reading has spent for enclosed disk signals from $1,500 to $4,000 per mile of road. Cost per mile varies according to length of the block sections and frequency of switches. The larger sum refers to lines with more than two tracks with a distant signal for each home signal, the distant being on the same post with the home signal of the next block section in the rear. Cost of disk signals has been reported in various cases as about $400 per signal. Cost of maintenance of disk signals has been reported at from $67 to $100 per signal per year. For semaphores worked by electric motors, actuated by batteries, a complete equipment for a double-track line, with distant signals, costs from $1,200 to $1,800 per mile.

"Cost of electro-pneumatic signals on a four-track railroad, with block sections averaging three-fourths of a mile long, in a certain case, $5,000 a mile, which, of course, included distant signals. The cost of maintenance of signals of this kind for one year, including oil and attendants for the lamps, material and attendants for batteries, air compressing and repairs to compressing plant, is given for one four-track railroad as $33.93 per signal arm. Cost per mile of road, with blocks of the length just mentioned would, therefore, be $362 a year."

## CURRENT NEWS AND NOTES.

*MR. HENRY VILLARD* has left $50,000 unrestricted to Columbia University, New York City, by his will, just probated; and an equal amount to Harvard.

*CHICAGO ELECTRICAL ASSOCIATION.*—The officers of the association for 1901 are: R. F. Schuhardt, president; Harold Almert, vice-president; H. G. Dimick, treasurer; W. B. Hale, librarian; G. M. Mayer, auditor; directors: L. G. Bassett, J. R. Cravath and H. P. Clausen. Mr. W. J. Warder, Jr., 242 South Jefferson Street, has been elected secretary.

*AN EXHIBITION OF FIRE APPLIANCES.*—An international exhibition of appliances for protection and rescue from fire will be held in Berlin, Germany, in June and July, 1901. Mr. Von Podbielski, Postmaster-General of the German Empire, invites a large display of appliances from the United States. Copies of the programme of the exhibition may be obtained by addressing the German embassy, Washington.

*NEW YORK ELECTRICAL SOCIETY.*—The 211th meeting of the society, through the courtesy of the New York Gas & Electric Light, Heat & Power Company, will be held at the Edison Station, corner of Elm and Duane Streets, on Wednesday, Jan. 16, at 8 p. m. Dr. Louis Bell will deliver a lecture on "Electric Illumination at the Beginning of the Twentieth Century." Unusual preparations have been made for this lecture. Ladies will be welcome.

*ELECTRIC LIGHT IN YOSEMITE PARK.*—The Yosemite Commissioners in their annual report to the Governor of California, asked for an increase of $35,000 in the appropriation for keeping up the park. It is proposed to expend $25,000 for an electric lighting and road-sprinkling system. The electric system will be used to light the hotel and some of the roads. It is also proposed to illuminate Yosemite Falls, 2,600 ft. in height, by the use of 20 arc lights in connection with devices for producing color effects.

*A MODERN HOTEL.*—Rudolph M. Haan has leased from John Jacob Astor the five lots on the southeast corner of Fifty-fifth Street and Fifth Avenue, New York City, together with a sixteen-story basement and sub-basement fireproof apartment hotel which will be erected there. The lease is for twenty years, with the option of three renewals. It is proposed to introduce a system of electric service elevators, and movable pantries, fitted with electric heating tables. These will be run through every apartment, thereby insuring rapid service and hot food to guests taking their meals in their rooms.

*ELECTRICITY AT OXFORD.*—Prof. T. S. Townsend, of Trinity College, Dublin and Cambridge University, has been appointed to the newly-established Wykeham professorship at Oxford. Commenting on this appointment, *Science* says that while the abilities of Mr. Townsend are fully recognized, and it is expected that he will place the teaching of electricity on a satisfactory footing at Oxford, yet some dissatisfaction is expressed that an Oxford man should not have been elected. In the present case, however, the complainants can scarcely point to an Oxford electrician suitable for the post.

*ELECTRIC RAILWAY MOTOR.*—A patent granted Jan. 1 to Edw. J. Priest describes several improvements in the direct-current electric railway motor. With the object to increase the effective length of the armature without increasing the external dimensions of the motor, the shaft is made stationary and fixed in two lugs formed integral with the lower half of the motor case. A sleeve on the shaft carries the armature, there being a bearing in the form of a bushing at each end of the sleeve. Both bearings are thus entirely enclosed by the magnet frame, which enables the length of the armature to be increased by the space that otherwise would be required for an external bearing.

*A TROLLEY CAR ORIGINAL.*—It is stated from New Haven, Conn., that Benson Bidwell, of Hartford, will bring suit in the near future in many of the United States District Courts of the country against over a hundred electric road corporations for infringements of patents. Mr. Bidwell, some fifteen years ago, evolved a system of applying electricity to trolley car propulsion identical, he asserts, with the systems now used by trolley roads all over the country. For this invention, which he says was patented, he never received any remuneration, though trolley companies throughout the world are using it. He asks damages and royalties for the fifteen years, the whole sum amounting to hundreds of millions of dollars. His suits will also be brought abroad, where his system is used. Meantime the threatened parties are inert and somnolent.

*WIRELESS TELEGRAPH APPARATUS.*—A patent granted Jan. 1 to Warren S. Johnson and Charles L. Fortier relates to improvements in the construction of wireless telegraphic apparatus, which improvements are claimed to increase the efficiency and render more positive and reliable the operation of such apparatus. The main feature described consists in the use of an air-blast for decohering. To prevent corrosion or injury to the metallic pipe of the coherer, the compressed air, or other gas by which decoherence is effected, passes through a receptacle containing calcic chloride or other material for depriving the air, or other gas, of moisture. In order to protect the receiving coherer from the influence of neighboring sending apparatus, with each depression of the signal key air is admitted to the coherer and the filings are thus agitated and held in a non-conductive condition at the moment when powerful wave impulses are produced by the transmitting instrument. When the sending key is released, electrical connection is established between the aerial conductor and the coherer, thus at each operation momentarily putting the apparatus in condition for the receipt of messages or signals from a distant station.

*INDEPENDENT TELEPHONE SERVICE.*—General Manager James M. Thomas, of the United States Telephone Company of Cleveland, and president of the Independent Telephone Association of the United States, referring to the possibilities of the formation of a combination of independent telephone companies of the country, stated that so far as he could learn the recent story of a $50,000,000 combination had little foundation. Several of the eastern organizations, which are merely large corporations on paper, have been advocating a combination, he said, but the companies having properties in actual operation are well satisfied and can see nothing to gain in a combination. He stated that the western companies constantly are making alliances for long distance traffic, but the arrangements are not combinations in any sense of the word. For instance, the United States Telephone Company has lately made a traffic arrangement with the Pittsburg & Allegheny Telephone Company of Pittsburg, whereby the companies reached by United States lines will have access to all points in Western Pennsylvania and in the near future will have direct connection to Baltimore and points in Maryland. A similar arrangement has been made with the Interstate Telephone & Telegraph Company, of Philadelphia, whereby points in Western Pennsylvania will be reached. This company will also give direct connection with Jersey City.

*THUNDERSTORMS IN HUNGARY.*—July is a month of thunderstorms in Hungary. Last July 33 persons and 286 sheep were killed by lightning. No explanation is offered.

*"DUPLEX TELEPHONY."*—The Chicago Telephone Company a few days ago sent out a circular urging its customers to have their telephone business double-tracked—one instrument for outgoing business and one for incoming. Some smart local reporter who got hold of it thought it was a plan for "duplex" telephony and so heralded it to a startled public. General Manager Hibbard has been kept busy explaining the thing to his telephonic friends in different parts of the country.

*THE NORTHWESTERN ELECTRICAL ASSOCIATION.*—Following is a partial list of the papers which will be read at the Milwaukee convention of the Northwestern Electrical Association on Jan. 16: "The Rate Question," by Henry L. Doherty; "Synchronous Converters," by Prof. Goldsborough; "The Series Incandescent Lighting System of the Future," by P. D. Waggoner; "Practical Line Construction," by Loren W. Burch; "Education of Central Station Employees," by Prof. D. C. Jackson. Others will be read and discussed. The annual banquet will be held on Thursday night, Jan. 17.

*NEW CABLES IN PHILIPPINES.*—According to cable dispatches from the Philippines, the United States cable ship Burnside is now proceeding to Damuguete, Island of Negros, to begin the laying of 600 miles of Government cable to connect Negros, Mindanao, and Jolo. Negros and Cebu already have cable connection with Iloilo and Manila. The new line will extend from Damuguete to Oromaueta, Misamis, Iligata and Tagaloan, all on the north coast of Mindanao. A land line will connect Misamis and Tigum and the main portion of the cable will extend from Tigum to Zamboanga and thence to Jolo. At present there is scarcely any telegraphic communication with Southeastern Luzon, owing to the persistent wire cutting. It is proposed eventually to connect that section and the larger islands adjacent by cable with Manila. A detailed map of all this projected work appeared not long since in these pages.

*ELECTRICITY AS FOOD.*—According to the *Saturday Evening Post,* Dr. W. J. Herdman, of the University of Michigan, has made the discovery that the "galvanic current" promotes the growth of tissue, and has expressed the belief that pigs may be fattened by a diet of electric current. Commenting upon this, our contemporary says: "Nobody can say what may be the final influence of this new discovery upon the packing trade, or whether the "electric bacon" of the future may not command a special price in the market. The imagination extends the application of Dr. Herdman's discovery to almost any lengths. Why may not the day come when every cow in her stall shall have her private wire? And if electricity is good for pigs, it may serve to fatten babies, or even grown persons who are desirous of increasing their avoirdupois, and thus most interesting possibilities for the improvement of the human physique are opened up."

*AUTOMOBILE FOR POSTAL USE.*—Although the Post Office Department took pains in its latest advertisement for proposals for carrying the mails through cities, between post offices and railway stations, to incorporate a special invitation to automobile and locomobile companies to compete, not a bid of this sort has come in. The default is explained by the experts on the ground that a large wagon loaded with full mail pouches is a very heavy vehicle, and that the mechanical motor needed to impel one must be proportionately heavy, combining to make a tremendous weight with rather indifferent apparatus to control the momentum it is liable to acquire. "An electric storage battery of the size necessary to move such a mass is said to cost $500, and to have so short a life that it would probably have to be changed three times a year, if not oftener, even in a city where the distance traveled daily is as small as in Washington. This would mean an expenditure with each change of enough money to buy a good pair of draught horses, and no contractor could afford, at the prevailing rates of compensation, to change two horses so often as that. Horses have to be fed and stabled, it is true, and they do sometimes fall ill and require medicine and surgery. But the recharging of batteries, the incidental rapairs, and the liability to costly accidents are all to be included in estimating the possible expenses of a motor service."

*THE ELECTRIC LIGHT IN SPONGE FISHING.*—There are to-day some 310 vessels, with more than 2000 men, employed in this one industry about the coast of Florida. As it takes at least a year for a sponge to grow to a moderate size, and the grounds are fished over several times every twelve months, the large sponges have all been removed from the available portions of the ocean's bed and the large fleet of fishing vessels keep the product limited to sponges of small value. The United States Commission of Fish and Fisheries has recently taken steps toward the regulation of this wholesale destruction of the young sponges on those submarine plateaus which are now accessible. The operation of collecting the sponges is very simple, the fisher spearing with a long pole all those which he can see by the aid of a water glass. The depth of water, therefore, in which they can be obtained is only limited by the distance penetrated by the light. If this distance could be increased, large areas would immediately be opened up where sponges have been growing unmolested for years, and the production would be not only greatly increased in quantity but the quality would probably be as fine as that from any part of the world. Experiments are soon to be made upon a new submarine electric arc lamp to ascertain by practical demonstration the feasibility of reaching these lower strata by its means, and if successful its application to this important industry will undoubtedly follow.

*MUNICIPALITIES' LIABILITY.*—The Judiciary Committee of the House fixed Jan. 11 for hearing at Washington the representatives of municipalities relative to the bill proposing to give the Federal courts means of enforcing their judgments against municipalities. An important departure from existing law is involved in the proposition, and one affecting all cities and towns which borrow money on bonds or otherwise. The serious increase in municipal obligation is being recognized as a national peril. At present there is no means of enforcing judgments from the Federal courts on these obligations, and many peculiar conditions have arisen through efforts to enforce them. The United States Supreme Court has ruled that mandamus against the local tax officers to compel them to put the obligation on the tax rolls is the only remedy. But in several cases the local officials have avoided the mandamus by resigning. Several exciting incidents have occurred in some of the cases, the local officials taking to the woods to avoid service. The judgment of creditors, representing directly and indirectly many millions of dollars of claims against municipalities have been heard by the Judiciary Committee, and it is now the committee's desire to hear from the municipal debtor class. The plan under consideration is to authorize the United States District Court at the place where a municipality is in default and the local officials fail to act, to appoint a special tax officer to assess the tax. Representative Jenkins, of Wisconsin, chairman of the sub-committee having the matter in charge, says it is the first instance in which the power of the Federal courts is sought to be extended to municipalities. Aside from the many millions involved, Mr. Jenkins says the matter is specially important not only to municipalities in default, but to those desirous of protecting their credit and securing low interest rates.

*NEW CENTURY RAILWAY TENDENCIES.*—Mr. James J. Hill, president of one of the large American railroad systems, says with regard to future railway tendencies, in the *World's Work* for January: "The forces likely to determine in future the construction of new lines of railway in the United States are the need for better terminal facilities, and the special requirements of particular sections. That the building of great trunk lines has come to an end is shown, I think, by the fact that during the past dozen years there has been a steady decline in railway construction in all parts of the United States. A railway that will not yield a prospective profit to its projectors has no legitimate reason for existence, and, as the existing lines between the West and the East are prepared to transport twice or thrice the tonnage now offering, or likely to offer for many years to come, to attempt to parallel them with new ones would be a financial blunder little better than a crime. The competition of older rivals and the consequent division of business would render the stocks and bonds of the newcomers practically worthless, and investors have learned caution from the disasters of the past. Lines now in operation are pretty sure to seek and secure improved outlets, and there is bound to be a small but steady increase in mileage having for its object the development of some particular interest or section; but more than that should not be looked for in the near future. Indeed, in most of the States of the East and Middle West, the existing mileage supplies all the facilities wanted. In such States no con-

siderable amount of new mileage can be built with the assurance of profit, and this fact will exert a salutary influence in checking doubtful ventures and compelling obedience to the very excellent rule that where a line is capable of handling the transportation of its section, the construction of a second should not be undertaken. Capital seeking investment will be mainly directed in future to the development of urban and interurban electric railroads, a department of transportation which is still in its infancy."

# LETTERS TO THE EDITORS.

## Determining Rail Joint Resistance.

*To the Editors of Electrical World and Engineer:*

Sirs: I notice that in an editorial on page 3 of your last issue you refer to a useful apparatus "recently described in a foreign contemporary" for determining the resistance of rail joints in terms of the rail length. You are certainly correct as to the value of this device, but you need not have gone abroad to have learned of its use, as this method was described by me in full in the *Street Railway Journal* for May 5, 1900. The device described in the *Journal* contained an improvement over that mentioned by you in that resistance coils external to the instrument are used to make a differential measurement. In this way an instrument of high sensibility can be used, and the rail contact resistance becomes negligible. By a slight change in the instrument described in the *Journal* it can also be used to determine the current flow in the rail.

NEW YORK CITY. ALBERT B. HERRICK.

## Compound Dynamos as Motors.

*To the Editors of Electrical World and Engineer:*

Sirs:—I am very much interested in Mr. J. T. Freeman's letter, published in your issue of Dec. 22, 1900, regarding "Compound Dynamo as a Motor," to which I will endeavor to answer, as follows:

His machines undoubtedly operate satisfactorily while running as generators, at which time the compound windings of both machines are in multiple with each other. When he releases the friction clutch on the engine, thereby causing the generator to stop generating and run as a motor, driving the arc machine, the current consumed by the motor does not feed through the compound winding of the generator, but feeds the over equalizing bus, and the generator is operating as a shunt machine for the amount of current consumed by the motor. As the compound windings are still in multiple, he gets but one-half of the compounding effect on the generator, as its compound winding is shunted by the compound of the motor.

If there is no load on the generator except the motor, he gets no effect of the compound whatever. Consequently the drop in voltage.

DETROIT, MICH. JAS. W. BISHOP.

## Incandescent Lamp Development.

*To the Editors of Electrical World and Engineer:*

Sirs:—In common doubtless with others I have read with much interest the narrative of Mr. Edwin W. Hammer concerning "Incandescent Lamp Development to the Year 1880," which recently appeared in your columns.

He begins, rightly, as I believe, by giving some consideration to the early incandescent lamp work of J. W. Starr, best known by the British Starr-King patent of the year 1845, but seems to have little more information about Starr than can be gleaned or inferred from that patent.

There is, however, further information at hand, and while some of it may be legendary, there can be no doubt that in a general way Starr's story is told with substantial correctness by articles or communications appearing severally in *Nature*, Sept. 7, 1877, pp. 459-460; the *Telegraphic Journal*, London, Jan. 1, 1879, p. 15, and the *Scientific American*, Jan. 18, 1879, pp. 40-41.

The *Nature* reference is a communication from Mr. Mathieu Williams, who says that he assisted Starr in his experiments on the light; that the results of the said experiments with batteries were such as to convince Mr. Starr that a magneto-electric arrangement should be used as the source of power in electric illumination, and further that Starr died suddenly in Birmingham in 1846, while constructing a magneto machine.

The *Telegraphic Journal* and *Scientific American* articles are more full in their details, especially the latter, and refer to a caveat filed by Starr for his light in the United States, reciting the claim thereof; speaking also of capitalists, including George Peabody, who were ready to assist him; of a kind of electric candelabrum whereon electric lamps were to be mounted of number corresponding to the States of the American Union, as they were at that time, saying that the system was exhibited to Faraday, who pronounced it a perfect success, and that Starr died suddenly during the night following the exhibition, the supposed cause of his death being "excitement and overwork of the brain."

THOMAS D. LOCKWOOD.

BOSTON, MASS.

## On the Standardizing of Steam Driven Generating Units.

*To the Editors of Electrical World and Engineer:*

Sirs:—The work now being done by the American Society of Mechanical Engineers and the Engine Builders' Association in the direction of promoting a more thorough co-operation between engine and dynamo builders in standardizing direct connected units should result in practical benefits to both makers and purchasers of such machinery. The subject resolves itself, or may be resolved, into three distinct branches, as follows:

1. Selection of standard units on the basis of capacity and speed.
2. Establishment of rules and standards as to overload capacity, regulation of speed and efficiency.
3. Standardizing such details of construction as affect mutually the two elements of the unit.

In regard to the first question above, it can be said that there is already a fairly well standardized line of direct current units in general use. Of course, in exceptional cases, as, for instance, where a Corliss engine is used for a small capacity unit or a relatively very high speed engine like the Willans is used, these standards cannot apply. Above 50 kilowatts the various makers of direct current dynamos agree very well as to sizes, but in the smaller units we have in common use 20, 25, 30, 40 and 50-kw units and specifications calling for 35 and 45 kilowatts are not uncommon.

I think three sizes should be sufficient to cover this range, and would suggest 20, 30 and 50 kilowatts as the most desirable. In the case of alternating current dynamos it would seem desirable to establish, if possible, two standard frequencies before deciding on sizes of units. This question of sizes is, of course, purely a commercial one, and to secure satisfactory results it will be necessary to get the various manufacturers and consulting engineers to agree upon the standards to be adopted.

The second branch of the subject deals with engineering questions entirely, and the various points should be settled on the basis of the best that can be accomplished without requiring expensive additions, having little or no practical value, to existing machinery, or adjustments too delicate for practical service. In regard to overload specifications, the aim should be to secure a margin of safety sufficient to take care of reasonable momentary overloads without injury to the machinery or interruption of service. Consulting engineers are largely to blame for the extravagant overload requirements so frequently called for, and which often seem to indicate a lack of faith in the builders' ratings. I can find no sound argument for great overload requirements. It is rather like trying to get something out of nothing. A machine that will carry 25 per cent overload continuously is simply underrated; and as for the argument that efficiency should be maximum at average load, it must be remembered that the difference in the efficiency at one-half load and at full load of a dynamo does not exceed 3 per cent; consequently there is very little possible gain in efficiency in providing machines the rating of which approximates the average load. This reasoning, of course, does not apply with equal force to the engine end.

In special cases where heavy loads are more than momentary and the average load is relatively small, it would probably produce more satisfactory results if the conditions were stated in the specifications and the manufacturers permitted to work out the proposition on the basis of meeting the conditions to the best advantage.

The above remarks apply to overload requirements exceeding, say, 50 per cent momentary and 25 per cent for one hour, which I would suggest as a standard. The standard for regulation can be readily determined for direct current dynamos by taking the best practice of to-day. With alternating current generators something more is required, and improved methods may be looked for. The question of efficiency is a serious one, and it is most desirable that some standard be generally adopted.

The separation, with accuracy, of engine and dynamo losses is well

nigh impossible. A common method of making efficiency tests of direct connected units is to consider the engine losses the same at all loads. Obviously this method is inaccurate, and as these engine losses are determined from the card taken at no load, the result will throw the additional losses in the engine, when loaded, on the dynamo, making the latter appear lower in efficiency than it really is. It must also be remembered that the dynamo builder of to-day is required to guarantee the highest efficiencies attainable, which efficiencies are determined by extremely accurate electrical methods, while the value of his guarantee depends on the relatively inaccurate results of indicator tests. Whatever standard may be decided upon, it would seem that only an empirical rule can be established, as, for example, the allowance of a fixed percentage to cover the difference between no load and loaded engine losses for each size of unit.

The details of construction, which I have made the third branch of the subject, might perhaps be more properly put first as being of more immediate importance and more easily settled. It would seem only necessary for the engine and dynamo builders to get together to arrange these details in a satisfactory manner. The dimensions of shafts should first be determined by the engine builders, who should obtain the weights of armatures and the magnetic pull due to, say, a displacement of 1-16 in. from centre of field. The diameter of such shafts is chiefly if not entirely determined by the above factors plus weight of fly-wheel and distance between bearings. There should be no difficulty in coming to an agreement on shaft diameters. Standard allowances for forcing fits should also be made, and the decision of this, I think, belongs to the dynamo makers. Regarding mounting armatures on shafts, I advocate doing this in the case of side crank and coupled shafts, at the dynamo works, wherever possible or economical. In the case of centre crank shafts, this work should be done at the place of erection. In the case of double cranks (cross compounds) send the armatures to the engine works and let it be prearranged that the dynamo builder have his man on hand to look out for the handling of the armature. The reason for this suggestion is that few dynamo works are equipped to force on the crank properly after putting the armature in place. With machines under 200 kilowatts it is an easy matter to put in shafts at the place of erection if a suitable tap hole is provided in the shaft, but it is cheaper in most cases to do it at the dynamo works.

In regard to bases, I think that in the smaller units having extended sub-bases, comparatively few patterns would be required if these are made with slides allowing them to be widened and lengthened, and vice versa, to accommodate the differences in dimensions between different makes of the same capacity. It should also be possible by means of loose pieces to adapt the same patterns to vertical or horizontal split dynamos. Possibly some engine builders do not realize that the days of "freak" dynamo design have passed, and the ring with two feet is now universal. One thing, above all, must never be lost sight of in designing bases and foundations for dynamos and outboard pedestals, and that is that on the front of every dynamo, be it of any make, size or kind, there are more or less rocker rings, cables, terminals, brushes, collector rings, etc., and that it is sometimes necessary to get at these things, and therefore the base should be designed to give ample space in front of the magnet frame. It is to be hoped that these matters will receive the careful attention of those interested and that we will, in the near future, have generally accepted standard rules of practice covering each of them.

BROOKLYN, N. Y. F. V. HENSHAW.

# DIGEST
OF
# CURRENT ELECTRICAL LITERATURE.

### DYNAMOS, MOTORS AND TRANSFORMERS.

*Large Alternators.*—HEYLAND.—The conclusion of his "Notes on the design of large alternators" (Digest, Jan. 5). In summing up he says that the principle of designing alternators with abnormally high flux densities in the field system possesses two great advantages; it greatly reduces the pressure drop and it enables the rating of a standard carcass to be increased. He thinks that as soon as the advantages of this method of construction become more widely known, the principles will be generally adopted on account of the important bearing they have on the commercial aspect of alternator design.—Lond. *Elec. Rev.*, Dec. 21.

*Test of Steam Alternator.*—APPLEBEE.—An account of the results of a test of the steam consumption of a 300-kw steam alternator. The mean output of the alternator was 315 kilowatts. The mean horsepower shown by the indicator cards was 499. The combined efficiency of engine and alternator was 84.6 per cent.—Lond. *Elec., Elec. Rev.* and *Elec. Eng.*, Dec. 21; *Lightning*, Dec. 20.

REFERENCES.

*Theory of Synchronous Motors and Alternators.*—SEEFEHLNER.—An illustrated article in which he corrects some minor points in his paper noticed in the Digest Oct. 20 and Dec. 8.—*Zeit. fuer Elek.*, Dec. 16.

*Converters.*—PERKINS.—The conclusion of his illustrated serial, in which he deals with the use of alternating direct current motor generators and synchronous converters for railways.—*West. Elec.*, Dec. 29.

### LIGHTS AND LIGHTING.

*Nernst Lamp.*—NERNST and WILD.—An account of photometric measurements with electrolytic incandescent bodies, consisting of the oxides of zirconium, thorium, yttrium, etc. The incandescent bodies were all in the form of thin, straight rods. They took the photometric measurements in a direction perpendicular to the axis of the incandescent body, and "to get the average spherical intensity, the numbers are to be multiplied with a constant factor $\frac{\pi}{4}$" (= 0.785). The incandescent bodies are first heated with a flame; they become conducting at 500 to 700 degs. C. For one incandescent body the conductivity at 600, 800, 1000 and 1100 degs. was 0.0003, 0.0064, 0.036 and 0.099, respectively (in cubic centimeters divided by ohms). He gives the results of tests of four incandescent bodies of different sizes with varying currents. For one rod 17 mm in length and 0.32 mm thickness, the watts per candle were 1.72, 1.05, 0.76, respectively, for 0.15, 0.25, 0.35 amperes. For another rod 30 mm in length and 1.87 mm thickness, the watts per candle were 2.04, 1.02, 0.70, respectively, for 1.2, 2.4 and 3.2 amperes. He gives the results of life tests, from which it appears that "with an average load of 1.35 watts (= 1.73 spherical)" (1.73 is obtained from 1.35 by dividing by 0.785), the life of the thinnest rods is about 180 hours, and that of the thicker about 360 hours or more; at the end of this period the rod is not destroyed, but continues to give light, but with less economy. Nernst lamps consume about half the energy per candle that ordinary incandescent lamps do, but about 20 per cent more than large arc lamps. For comparison with the arc lamp it is to be remembered that Nernst lamps can be made for higher voltages, for instance, for 220 volts; that the Nernst lamp is entirely free from the flickering in the arc lamp; that the electrolytic incandescent bodies have a much longer life than the carbons of the arc, and that if, for instance, instead of one 400-watt arc lamp, two 200-volt Nernst lamps are used, a better distribution of the light is obtained; the pure white color of the light of the Nernst lamp is also to be taken into account.—*Zeit. fuer Elektrochemie*, Dec. 20.

*Direct Current Arc.*—DUDDELL.—The conclusion of his long, illustrated Brit. Inst. Elec. Eng. paper on "Rapid variations in the current through the direct arc," the first part of which was abstracted in the Digest Jan. 5. Under certain conditions the direct current arc will emit a musical note when shunted by a self-induction in series with a condenser. "When emitting the musical note the direct current arc transforms direct current energy into alternate current energy, the frequency of the latter being determined by the self-induction, capacity and effective resistance of the oscillating circuit." The pitch of the note emitted may be used as a means of comparing self-induction and capacities. If a direct current arc be shunted with a condenser of several microfarads capacity, the arc will generally be extinguished if the electrodes are of metal, and not if they are of cored carbon, the resistance in series with the arc being non-inductive. If the resistance in series with the arc be highly inductive, then when the metal arc is extinguished by shunting it with a condenser, a violent rise in p. d. occurs between the terminals of the arc. The rise

in p. d. that occurs when an inductive circuit is broken by means of a switch, the contacts of which are shunted by a condenser, is much higher if their contacts are of metal than if they are of cored carbon, owing to the condenser extinguishing the metal arc formed at the contacts more suddenly than the arc formed when carbon contacts are separated. There are two appendices, one on the resistance of the cores of cored carbons, the second on the conditions which govern the conversion of direct current into alternating current in the musical arc.—Lond. *Elec.*, Dec. 21. The first part of the paper also in Lond. *Elec. Rev., Elec. Eng.*, Dec. 21.

### POWER.

*Electric Plow.*—A brief article on the Borsig electric plow, which is used on German sugar estates. The cost of a complete plant, including engine, electric generating station, line construction, transformers, five electric plows and sundries, is $44,250. The plow works by means of two wire cables which run in a parallel direction over the field, about 3 ft. from each other.—*West. Elec.*, Dec. 29.

#### REFERENCES.

*French Water Power Plant.*—BORDEAUX.—An illustrated description of the water power plant of Chevenoz, in Savoy, for supplying current to the cities of Thonon and Evian for lighting. There are three 300-hp alternators, generating three-phase currents at 3300 volts. —*L'Ind. Elec.*, Dec. 10.

*French Transmission Plant.*—PERKINS.—An illustrated description of the monophase and three-phase plant at Chapareillan-Chamberk. The transmission line has a length of about 7 miles and a voltage of 15,000 is used.—*El'ty*, Jan. 2, 7.

*Naval Gun Circuits.*—An illustrated article in which attention is called to the advantages of the use of electricity for firing guns in the navy. The arrangements of the circuit for quick-firing guns are described.—Lond. *Elec. Rev.*, Dec. 21.

### TRACTION.

*Long-Distance Heavy Electric Railways.*—R. KENNEDY.—A brief article in which it is said that probably the best system is an alternating current primary supply at 20,000 volts or more, feeding stationary transformers of a ratio of 10 to 1 along the line; a secondary overhead trolley wire at 2000 volts, feeding a locomotive carrying two rotary converters converting the 2000 volts alternating to 400 or 500 volts direct current, this 500 volts direct current to work motors on each locomotive axle by ordinary controllers. Or even 100-volt direct current might be used, and 50 large storage cells carried on each locomotive, capable of moving without the trolley; these cells could be charged from the converter. The converter should be a very high speed synchronous motor connected to a direct current generator. Such a system requires attendance only at the generating and at the consuming end, while "the losses would be a minimum in transmission." A single-phase system seems to be the simplest for the purpose. The battery would save all complications at crossings, junctions, round houses, and so on. The field of the generators and motors on the locomotive would be better excited from the battery; then, by keeping the motor fields constant, and by varying the generator fields by rheostat, perfect regulation can be most economically obtained without any trouble.—Lond. *Elec. Rev.*, Dec. 21.

#### REFERENCES.

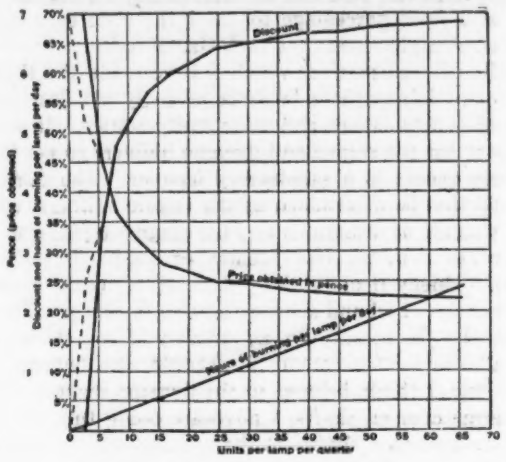
*Tramway Equipments.*—An illustrated description of tramway motors and controllers of the Brush Elec. Eng'ing Co.—Lond. *Elec. Rev.*, Dec. 21.

*Railroad Switches.*—SCHNATTER.—An illustrated description in which a rail switch is arrested by the switchman at the point where it is located, but it is released electrically from a distant central station, after the train has passed that point; this is done by an electromagnetic device. The operator in the central station can tell whether the position of the switch is right.—*Zeit. fuer Elek.*, Dec. 9.

*Canal Traction.*—GERARD.—A well-illustrated article on electric haulage on the Charleroi Canal in Belgium, which was noticed before in the Digest.—*Cassier's Mag.*, Jan.

### INSTALLATIONS. SYSTEMS AND APPLIANCES.

*Charging for Electrical Energy.*—A. W. D.—A method of charging based on a price of 14 cents a unit as a maximum, with rebates for long hour consumers. The total number of lamps of 8 candle-power and 30 watts which a consumer has installed is first ascertained; the consumption of the meter is read off; the reading is divided by the number of lamps and the discount is obtained from the accompanying curve. This method charges a consumer having many lights installed and a low maximum demand, at a higher rate than one with few lights and high maximum demand; to overcome this a supplementary curve is shown dotted, which he thinks fits the case and the increased maximum demand caused by charging on a basis of all the lights installed, is balanced by the rebates as shown dotted. By Wright's method a large consumption for a single night or even a single hour compels the consumer to pay full rates for the whole of the quarter, while by the pesent system this is not the case. At the same time the latter induces consumers to place lamps only where they will be really used and not to have a lot of lamps seldom used. The curve can be made to suit any price per unit desired. The system




CHARGING FOR ELECTRICAL ENERGY.

does away with the demand indicator, makes the system of charging simpler and capable of being easily understood by the average consumer, and relieving him of the bugbear of a demand indicator.—Lond. *Elec. Rev.*, Dec. 14.

*Development of the Density Factor.*—TURNBULL.—A paper read before the Newcastle section of the Brit. Inst. of Elec. Eng. The density factor of a plant may be defined as the number of 8 candle-power connected per $5 worth of mains laid, or, perhaps better, as the number of units sold per year per $5 worth of mains laid; mains in this case should include transformers and similar apparatus. He gives the density factors of six British towns; for the first definition based upon the number of lamps, they varied between 0.64 and 1.21, for the second definition based upon the number of units sold, they vary between 6.5 and 25.4. The cost of transformers is not taken into account in these figures. In a system of rented wiring, he suggests the following points: To charge a fixed quarterly rental for a plain fitting, including lamp and switch complete; to charge at a second and lower rate additional fittings on the same switch; to charge at a third and still lower rate additional lamps on a fitting not having independent switches; the hirer should have the option of "hire-purchasing" the installation at rates based on the rentals, or he should be allowed to purchase them outright at any time for a reasonable sum. Regarding the maximum demand system of charging, he says it has always been the trouble that consumers fear that their accounts will go up suddenly if they happen to put on extra lamps some night; he suggests allowing consumers to have two meters, one for long-hour lights, and the other for the remainder. The units registered by each meter are charged as if for separate consumers, so that practically the full rebate is obtained on the long-hour lights and no rebate on those occasionally used.—Lond. *Elec., Elec. Eng.*, Dec. 21. In an editorial on this paper it is said that what is required is not an increase or decrease in the factor of consumer density, in whatever way this be defined, but a network so designed that while the initial capital expenditure is kept as low as possible, the cost of extensions and amplifications shall not be unduly great. Furthermore, it is not additional consumers that are needed per yard of main or additional lamps, but additional long-burning lamps—in fact, a better load factor.—Lond. *Elec.*, Dec. 21.

*Electricity in a Locomotive Shed.*—An illustrated description of the electric equipment of the Southeastern & Chatham R'y Co.'s locomotive sheds at Slade's Green. Electric current is used for power purposes and arc lighting, and for a number of 230-volt incandescent lamps. The two 100-kw steam-driven dynamos are connected across the outers of the 460-volt three-wire system, the middle wire being connected between the two sides of a battery, consisting of two sets of Tudor cells with a capacity of 324 ampere-hours at a three-hour dis-

charge rate, and with an emergency output of 200 amperes for half an hour.—Lond. *Elec.*, Dec. 21.

REFERENCES.

*Combined Heating and Lighting.*—An illustrated description of the Evanston central station, using the Yaryan hot-water system for the supply of heat to a territory of six or eight square miles of area, with a supply of electricity for lighting as a by-product. A three-wire 220-volt system with compensator, and 110-volt lamps is used, the capacity of the electric plant being 225 kilowatts.—*West. Elec.*, Dec. 29.

*Power Station Design.*—DAWSON.—An article on modern electric power stations and some conditions governing their design. The differences between the requirements of a lighting plant and a traction plant are shown and some statistical data are given regarding British plants.—*Cassier's Mag.*, Jan.

*Small British Lighting Plant.*—An illustrated description of the water power plant of Fladbury, a small village in Worcestershire. There is a turbine driven 10-kw compound dynamo, supplying a two-wire circuit, the pressure being 220 volts.—Lond. *Elec. Rev.*, Dec. 21.

*Calculating Storage Batteries for Installations.*—SUCHY.—An article, illustrated by diagrams, in which he develops formulas for calculating the size of a storage battery, which is required, if the load curve for discharge is given.—*Zeit. fuer Elek.*, Dec. 16.

## WIRES, WIRING AND CONDUITS.

*Electric Fire Risks.*—WYNKOOP.—He shows the advantages of systematized electrical inspection and advocates the passage of suitable laws providing for the licensing of electrical workers. He shows how fire risks arise from poor joints or the use of too small a size of wire, and that a fuse is no protection against the heat developed at bad joints or at points of local leakage.—*Cassier's Mag.*, Jan.

REFERENCES.

*Regulations.*—An abstract of the projected law for Switzerland concerning regulations for electric installations.—*Revue de l'Elec.*, Dec. 15.

*Concentric Cables.*—O'GORMAN.—A communication referring to a suggestion of Duddell on a danger with concentric cables and metal break, quick break switches, and its reasons.—Lond. *Elec.*, Dec. 21.

## ELECTRO-PHYSICS AND MAGNETISM.

*Self-Inductance and Electric Inertia.*—SCHUSTER.—Abstracts of two Brit. Phys. Soc'y papers. The first deals with "Electric inertia and the inertia of electric convection." Calculations of self-induction are based on the assumption that the currents which traverse a conductor fill it continuously, the flow being treated as that of an incompressible liquid. If, however, the current consists of positive and negative electrons moving with different velocities, the magnetic field in the neighborhood of an ion is many times greater than that calculated on the supposition of continuous distribution, and hence the total magnetic energy is underestimated. He calculates the additional terms which become necessary for the evaluation of self-induction, and discusses the possible cases in which the corrections may affect experimental results. It is necessary to add a correcting term containing a quantity which may conveniently be called electric inertia. In the second paper he applies this to the theory of terrestrial magnetism. If the earth's magnetism is due to electric currents, he investigates whether the effects of inertia can explain the secular variation of the magnetic elements. He finds that a magnetic precession of the character of the secular variation would be produced, but that the precession would be very much slower than the variations actually observed.—Lond. *Elec., Elec. Rev., Elec. Eng.*, Dec. 21.

*Refractive Index and Dielectric Constant.*—FLEMING.—A communication on Maxwell's law that the square of the optical index of refraction of an insulator should be numerically equal to the dielectric constant. Starting with Larmor's conception of the electron as a strain-centre in the ether, he proceeds to show deductively how it can be that certain dielectrics behave at all temperatures according to Maxwell's law, while certain anomalous dielectrics are brought into agreement with that law only when, by means of a low temperature or by high frequency alternations of electric stress, their molecular and electronic conditions are made conformable to that law. In an editorial note Flemings' deduction is called "An excellent piece of reasoning. We have nowhere seen the electronic theory more lucidly and convincingly applied."—Lond. *Elec.*, Dec. 21.

*Electric Oscillations.*—FLEMING.—An abstract of his fourth concluding lecture on "Electric oscillations." He discussed the properties of electric waves. The term "electric displacement" has not yet been thoroughly defined. He showed Hertz's experimnts, a coherer being used as wave detector. After discussing experiments on reflection and refraction he explained that the reason why wireless telegraphy is much more successful over sea than over land is because the land absorbs the waves, whereas they are reflected from the surface of the water. He remarked that in the new century "electrical engineers will have to become more and more ether engineers."—Lond. *Elec. Eng., Elec.*, Dec. 21; *Lightning*, Dec. 20.

*Electron Theory of Metals.*—DRUDE.—A paper in which he seeks to explain the electric current and its effects in the magnetic field by the hypothesis of the movement of electrons or corpuscles between the atoms of the metals of the conductors. He finds sufficient agreement with known facts to make the hypothesis plausible, but he points out that it is highly desirable to collect observations on the four transverse-galvanic and thermo-magnetic effects, together with the thermic, the electric conductivity and the Thomson effect in the same piece of metal, in order to prove his theory.—*Ann. der Physik*, No. 11, noticed in *Am. Jour. of Sc.*, Jan.

## ELECTRO-CHEMISTRY AND BATTERIES.

*Carbon as Electrodes.*—WINTELER.—A discussion of the properties which carbon should have when used for electrodes in electrolytic processes. When used as anodes in aqueous chloride solutions it should be as free as possible of carburets of hydrogen and of inorganic impurities, which are acted upon by the electrolyte or by the anode deposits; these requirements are best fulfilled by retort carbon; the gas development should be as much as possible at the surface, and the current density should not be over 2 amperes per square decimeter. Other properties are required in the aluminum and carbide manufacture. For the production of aluminum purified artificial carbon free of silicium compounds is the best. For carbide manufacture artificial carbon should be used, obtained from powdered retort graphite or powdered coke, and need not be purified from organic impurities except those containing phosphorus.—*Zeit. fuer Elektrochemie*, Dec. 6.

REFERENCES.

*Electrolytic Production of Caustic Potash and Soda.*—WINTELER.—An article giving tables of the solubility of an aqueous solution of chloride of potassium in caustic potash at 20 degs. C. of chloride of sodium in caustic soda, of chlorate of soda in chloride of sodium, and of chlorate of potassium in chloride of potassium. These tables are useful in practice.—*Zeit. fuer Elektrochemic*, Dec. 6.

*Electro-Chemistry in 1899.*—The conclusion of the article, giving brief descriptions, of new processes or improvements, taken from patent specifications. This part deals with compounds of metalloids and metals, also with reductions, oxidations and syntheses in organic chemistry.—*Elek. Anz.*, Dec. 16.

*Electrolytic Production of Alkaline Metals.*—FISCHER.—An illustrated description of improved apparatus for the production of alkaline metals by the electrolysis of melted chlorides.—*Zeit. fuer Elektrochemie*, Dec. 6.

*Stirrer.*—NEUMANN.—A brief illustrated description of a stirrer to be used for electrolytic processes requiring energetic stirring during the measurement of the escaping gases. It seems to be more practical than that of Loeb (Digest, Dec. 15).—*Zeit. fuer Elektrochemie*, Dec. 6.

## UNITS. MEASUREMENTS AND INSTRUMENTS.

*Compensation Method for Small E. M. Fs.*—BOSE.—A description of a simple method to be used with a millivolt and amperemter. The one used in the description has a resistance of 1 ohm and 150 scale divisions; when connected as in Fig. 1 it will serve directly for measur-

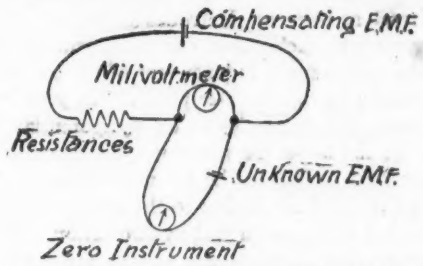



FIG. 1.—COMPENSATION METHOD FOR SMALL E. M. F.'S.

ing to 0.150 volt by adjusting the resistances. But the same instrument may be used for very accurate measurements of very small voltages by using the shunts that come with it, having resistances of 1 / 9,

1 / 99, etc.; one of these resistances is then connected in series with the millivoltmeter as shown in Fig. 2 and the reading will then be 9 times, 99 times, etc., that of the unknown e. m. f. No interpolation

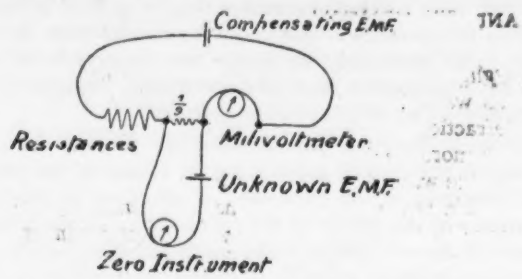



FIG. 2.—COMPENSATION METHOD FOR SMALL E. M. F.'S.

is required and no standard cell and even the compensating resistances need not be known.—*Phys. Zeit.*, Dec. 8.

*Defense of the Cadmium Cell.*—JAEGER.—A reply to the criticisms by Barnes and Cohen, concerning the Weston cadmium cell, noticed before in the Digest. "That the e. m. f. of the cadmium cell shows certain irregularities at zero deg. C. was already found by Wachsmuth and the author in 1896, and at that time they indicated 5 degs. C. and 25 degs. C as the limits within which the new standard cell could safely be used. Similar irregularities are known to occur in the Clark cell, due to the transition point occurring at 39 degs. C., below which the zinc sulphate may assume two different states, the normal curve being broken with respect to the portion above 39 C. Such a behavior cannot be traced in cadmium sulphate. The metastability of the Weston cell must therefore be explained on some other ground, and this both the author and his critics now agree to find in the behavior of the cadmium amalgam, which experiences irregular changes of structure at low temperatures. The concentration of the cadmium amalgam originally used was 14.3 per cent. It is now admitted that elements with that amalgam should not be used below a temperature of 10 degs. C. The cells brought out by the European Weston Electrical Instrument Co. contain an amalgam of only 12.5 per cent and they show no metastability even at zero C."—*Zeit. fuer Instrum.*, Nov.; abstracted in Lond. *Elec.*, Dec. 21.

*Simple Wehnelt Interrupter.*—VON PALLICH.—A description of a simple form of Wehnelt interrupter in which the lead plate is replaced by a copper wire and the platinum anode by a steel wire. "Both wires are enclosed in glass tubes, that containing the steel wire being strong, and tightly surrounding the steel tip. Both wires dip into dilute sulphuric acid. The steel wire is 1 mm or 2 mm thick, and its upper end is held in a cork provided with a cup for a mercury contact. The vessel containing the sulphuric acid is surrounded by cold water to keep the temperature down. The two glass tubes with their wires are inserted in a rubber stopper provided with borings to allow the acid to flow back into the bottle in case it spurts out. A curious phenomenon noticed in the working of the instrument is that the steel wears away just where the wire emerges from the glass tube, and not in the portion more immersed in the acid. A constriction is thus formed, and the effect appears to be that its formation assists rather than retards the generation of the gaseous layer, the explosions becoming stronger and more abrupt as the work of the interrupter continues. The double adjustment possible in this type of instrument makes it particularly easy to obtain the necessary current strength."—*Ann. der Physik.*, No. 11; abstracted in Lond. *Elec.*, Dec. 21.

*Method of Transverse Currents.*—STARK.—An account of an investigation of the theory and practice of the transverse current method of determining resistances. Two currents traversing a conductor in two different directions between electrodes situated upon equipotential surfaces with respect to each other, can be considered as simply superimposed, if the resistance is independent of the current density and if there is no polarization at the electrodes. "In practice it is almost imposssible to place the electrodes in an equipotential surface, especially in gases. In the latter the resistance does not correspond with the potential gradient owing to the internal charges. There is less conductivity near the cathode owing to the greater speed of the negative ions. This is a well-known fact in connection with incandescent lamps where transverse currents are almost inevitable."—*Ann. der Physik*, No. 11; abstracted in Lond. *Elec.*, Dec. 21.

*Measuring Instruments.*—ALIAMET.—The conclusion of his very long, illustrated paper on electric measuring instruments at the Paris Exposition. He concludes the description of voltmeters; discusses the measurement of resistance, resistance boxes, potentiometers, direct reading ohmmeters; deals briefly with condensers and inductances; describes wattmeters; several special instruments to be used with alternating currents, as phase meters, frequency meters, instruments for plotting the wave form; instruments for the study of the magnetic properties of iron, as permeameters and hysteresis meters; thermo-electric pyrometers for measuring temperature.—*Bull. Soc. Int. des Elec.*, Sept.-Oct.

*Effect of Tramways on Magnetic Observatories.*—RUECKER and GLAZEBROOK.—An abstract of a Brit. Phys. Soc'y paper by Ruecker on "The magnetic field produced by electric railways." In the case of a tramway in which the current flows along a trolley wire from the power house and returns partly through the rails and partly as earth currents, the vertical disturbing force at any point is due to the currents in the feeders and rails, and the earth currents affect only the horizontal force. Experiments show that it is chiefly the vertical force instruments which are affected by the existence of an electric railway; this disturbance is due to the wires and rails. He gives a formula for the vertical disturbing force. It increases with the length of the tramway, and for a tramway of given length it is a maximum at points on a line perpendicular to and bisecting it. In a paper by Glazebrook, Ruecker's formula is modified and utilized; among other things, he shows that a tramway of any given length at a certain distance from a magnetic observatory is many times more obnoxious to the observatory than a tramway half as long at half the distance.—Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, Dec. 21.

REFERENCES.

*Magnetometer Constant.*—CHISTONI.—He determines the constant of a unifilar magnetometer by placing a deflecting magnet at each of two distances from the needle. He gives two formulas, the first being rigorously correct, the second simpler, but only approximate.—*Acad. Sci. Torino*, atti 35, 8a, 1900; abstracted in *Science Abstracts*, Nov.

*Localizing Faults.*—An illustrated description of several methods of localizing faults in electric lines and cables, especially in difficult cases.—*Elek. Anz.*, Dec. 6.

## TELEGRAPHY, TELEPHONY AND SIGNALS.

*Wireless Telegraphy for Warning Vessels.*—A note on a successful trial of a new system of signalling, designed to warn vessels of their approach to points of danger. From the shore station ether signals are sent which may be read by such vessels as are within a certain distance of the danger point and are provided with proper receiving apparatus; this may be done continuously or only in foggy weather. The sending and receiving apparatus used was a modification of the Popoff vertical air-wire system designed by Hozier and Maskelyne, but the sending apparatus is made to give forth automatically the name of the danger point or other information concerning it. This is effected by using as contact-maker, in place of the Morse key, a revolving wheel, whose periphery is cut out appropriately. Editorially it is remarked that such a system can at its best afford but little guidance to a straying navigator.—Lond. *Elec.*, Dec. 21.

*Separation of Wireless Messages.*—JEGON.—A description of "a differential apparatus, which, while not preserving the secrecy of wireless messages, enables the sender to communicate at will with one or another of two stations situated at different distances. The principle adopted is that already proposed, of employing mast-wires of different ranges. Four such mast-wires are employed, two at the sending stations and two at the receiving stations. Their heights are so arranged that one of them covers, say, a range of 5 miles, while the other does not. The circuits of the coherers attached to the two mast-wires are so arranged that their simultaneous action produces no effect upon the galvanometer. But at a distance of 5 miles the galvanometer will respond to a message from the sending station addressed to both coherers, as only one of them is brought into action. At half that distance, when both coherers are within range, no effect is produced on the galvanometer. Thus, at all events, something of the nature of separation by distance is obtained, though it is open to the obvious criticism that complete neutralization of the two effects is only produced at one definite value of the distance."—*Comptes Rendus*, Nov. 26; abstracted in Lond. *Elec.*, Dec. 14.

REFERENCE.

*Telegraphy and Telephony.*—The first part of a summary of new inventions and improvements in telegraphy and telephony during October, November and December.—*Elek. Anz.*, Dec. 13.

### MISCELLANEOUS.

REFERENCES.

*Paris Exposition.*—ALIAMET.—An illustrated description of thermic voltmeters and registering wattmeters of J. Richard.—*L'Elec.*, Dec. 15.

MONTILLOT.—An illustrated description of an apparatus devised by Pecquet, for registering automatically at a certain station, the rounds of a watchman; the latter can give or receive an alarm signal at all the controlling stations; at all these places he can also communicate by telephone with the central station.—*L'Elec.*, Dec. 15.

An illustrated description of the exhibit of the Popoff system of wireless telegraphy.—*Elek. Anz.*, Dec. 13.

MONTPELLIER.—An illustrated description of dynamos exhibited by the Oerlikon Co.; a 350-kilovolt ampere single-phase alternator, the voltage being 2200 the frequency 50, the speed 250 r. p. m.; also a 1340 kilovolt ampere three-phase alternator, the voltage being 2200, the frequency 50, the speed 94 r. p. m.—*L'Elec.*, Dec. 22.

MONTILLOT.—An illustrated description of the telephone switchboard of the British Post Office.—*L'Elec.*, Dec. 22.

## New Books.

HANDBUCH DER ELEKTRISCHEN ACCUMULATOREN. Auf Grundlage der Erfahrung und mit besonderer Berücksichtigung der technischen Herstellung. Von Paul Schoop. Stuttgart; Ferdinand Enke. 514 pages, 193 illustrations. Price, 12 marks.

The book is limited almost entirely to the lead accumulator, there being only a few pages at the end devoted to other types, and is devoted largely to the practical construction of accumulators. The author discusses the raw materials; the manufacture of the grids or electrodes; the carriers of the active materials; the material to be filled into the electrodes; the formation of the plates; the electrodes with porous partitions; shipping and erection of batteries; transportable cells; and accessories. A chapter is devoted to the capacity, efficiency and resistance of accumulators; another to comparative measurements and tests, followed by a short chapter on the theoretical considerations, and concluding with another short chapter on other galvanic combinations than those in the ordinary lead accumulator.

The practical part of the book, dealing with the construction and manufacture of the storage battery, has evidently been compiled with great care from articles in journals, patent records, and prospectuses of manufacturers. The value of this part would have been greatly enhanced if criticism had been made more freely of the methods and constructions described.

The theoretical part of the book is brief. The author does not agree with what he calls the 'phantasies" regarding free ions, but is unable to offer anything better. The book will prove of value to the practical storage battery engineer on account of the large amount of information on technical details which it contains.

ELEKTROMETALLURGIE UND GALVANOTECHNIK. Ein Hand und Nachschlagebuch fur die Gewinnung und Bearbeitung von Metallen auf Elektrischem Wege. Von Dr. Franz Peters. Four volumes. Wien: A. Hartleben. 261, 292, 208, 240 pages; 72, 119, 59 and 33 illustrations. Price, per volume, 3 marks.

The author of these books, who is the editor of our German contemporary *Centralblatt fuer Accumulatoren und Elementenkunde*, remarks in the preface that although there are good handbooks on electrometallurgy and galvanic plating, a book was lacking giving a summary of all the various articles in journals and of the patents relating to the use of the electric current for producing and plating metals. For this purpose he has written these books, and has endeavored to give the literature of patents as complete as possible.

The compilation appears to have been done very carefully, so that these volumes may be used to advantage as reference books by practical engineers, inventors, and patent attorneys, whenever the question arises, whether a process is new or not; in such cases the books may save much labor.

The first volume deals with antimony, tin, bismuth, beryllium, magnesium, and aluminum, the latter filling by far the greatest part of the volume.

The second volume is a monograph on copper. The third volume deals with silver and gold, the fourth with zinc, lead, nickel, and cobalt. For each metal, first the electrolytic processes of production are described, then the methods of electroplating.

At the end of the fourth volume there are two indexes for the four volumes together, one of the names, the other of the patents; the latter are arranged according to the different countries.

JAHRBUCH DER ELEKTROCHEMIE. Von W. Nernst und W. Borchers. Berichte über die Fortschritte des Jahres 1894-5-6-7. Halle: Wilhelm Knapp. 1894—274 pages, 163 illustration, 10 marks. 1895—300 pages, 196 illustrations, 12 marks. 1896—359 pages, many illustrations, 12 marks. 1897—411 pages, many illustrations, 15 marks.

Since 1894 this yearly review of electro-chemical progress has been published annually, appearing usually in the spring of the year. Besides the above four volumes sent to us by the publisher, there are probably two later volumes, dealing with the progress of electrochemistry in 1898 and 1899.

Dr. W. Nernst is the editor of the scientific part of the year-book. He has been well known for years as one of the leading electrochemists of Germany. When he was Ostwald's assistant in Leipzig at the latter end of the eighties, he published his two famous papers on the phenomena of diffusion and of electric conduction in aqueous solutions, which phenomena were analytically treated as simply due to the traveling of the ions, the only acting forces being the osmotic pressure and the electrostatic forces due to the charges of the ions. These views of Nernst form the fundamental basis of our modern views of the electric phenomena in a galvanic cell. Dr. Nernst has besides been extremely successful as professor and as president of the electro-chemical institute of the University of Göttingen, where a very great number of electro-chemical researches have been made under his auspices. He has obtained a world-wide reputation also as the inventor of the Nernst lamp.

The editor of the practical part of the year-book is Dr. W. Borchers, who has been for a score of years an active engineer for electrochemical and metallurgical concerns, both in Germany and in the United States. He has also done considerable work in the development of the electric furnace. Some years ago his name came prominently forward as the inventor of a carbon cell, which, however, has not proved to be of practical value. He is at present professor in the Technical High School of Aix-la-Chapelle, and has published some valuable papers and books in which he has collected a great amount of statistical data, and has given good reviews of the progress and the present conditions of electro-metallurgy.

Both Dr. Nernst and Dr. Borchers are also the editors of the weekly *Zeitschrift fuer Elektrochemie*, which is the official journal of the German Electrochemical Society; though German in name, this society is international in membership.

In the later volumes of the year-book several chapters are written by Dr. Elbs, Dr. Kuester and Dr. Danneel, who are also contributors to the *Zeitschrift.*

We have given these notes on the authors of the year-book in order to show what may be expected from it, and add at once that it is of the highest value and of extreme usefulness to everybody interested in the progress in electro-chemistry. As an index of what has been done in each year it appears to be very full. The arrangement of the material is good; each volume has a full alphabetical index of the material, and another of the authors, so that it may be used to advantage as a reference book. Furthermore, it is not at all a conglomeration of brief, dry abstracts, but is so written that anybody interested in electro-chemistry will take pleasure in reading it over in leisure hours from the beginning to the end. It represents, of course, entirely the views of the modern German electro-chemical school and shows the accomplishments and the blind side of this school in being often too enthusiastic and not sufficiently critical in the judgment of new inventions; but this is natural in such a young science.

We hope that this German year-book will find friends in the United States. For the United States will, without any doubt, play a very important part in the future development of electro-chemistry, especially electro-metallurgy. In a paper of Dr. Borchers read in 1899, he gives the value of the different materials available per year in the electro-chemical plants in the three countries which lead in this respect, as follows: The United States, $97,500,000; Germany, $13,800,000; France, $11,300,000. In this respect the United States is far superior to all other countries of the world together. There is also no doubt that, in future, electrical processes will be used more and more in metallurgy as well as in the chemical industries. The older non-electrical methods are engaged in a struggle for life; and there is no doubt that they will ultimately be vanquished. To call the attention of young electro-chemical engineers to the German year-book, which can be a strong weapon in their hands in this fight, is the aim of this notice.

## Directory of Electrical Societies, Etc.

NEW YORK ELECTRICAL SOCIETY. Next meeting, Jan. 16. Lecture by Dr. Louis Bell on "Electric Illumination at the Beginning of the Twentieth Century." See Current News and Notes for further particulars.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Milwaukee, Wis., Jan. 16, 1901.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, New York, 1901.

## The Electric Automobile in Paris.

BY HART O. BERG.

The high place which the petroleum carriage has taken in the automobile field of France now shows some outward signs of being challenged by its more gentle and quite offenseless contemporary, the electric carriage. For several years those far-seeing in automobile circles have been forced to acknowledge that the petroleum-driven vehicle was not entirely suited for city work, and the demands of city people have been such recently as to aid in a great degree the rapid development of electrically driven vehicles of all descriptions. There has been a big fight on in the trade against electricity, as few people in France seemed to be prepared to spend the necessary amount of money to establish central stations, without which the difficulties arising in the development of an entirely new means of propulsion were such as to frighten prospective buyers. During the past year several charging stations, if they may be called such, have been established in the outskirts of Paris, but they were so far removed from the residential centres that good service was not easily obtained. The representative of the Electric Vehicle Company established a charging station which in every sense of the word can be called a central station. This is situated at 54 Avenue Montaigne, in the very heart of Paris. This station was established, not only to take charge of the already large number of Columbia automobiles running in Paris, but was equipped to charge and look after properly all types of electrically propelled vehicles. There is ample room in this station for from 50 to 60 carriages, and at the present time the stabling and charging facilities are utilized to their limit. In fact, it has become necessary to establish a second station, and ground for that purpose has already been acquired near the Arc de Triomphe. This second central station will be large enough to accommodate 150 carriages, besides which a large space has been set apart for battery care, as it has been the object of the company in Paris to pay special attention to batteries, thereby getting the very best efficiency. The carriages virtually take care of themselves and but little attention is necessary to keep them in perfect repair. The company does not conduct any renting business, all the carriages kept in their stations being owned by individuals. They are stabled, charged and kept in repair at a very nominal cost; in fact, at a price at which it would be impossible to keep horses and carriages, and it is needless to say that the service is giving every satisfaction.

The growing popularity of electrically propelled vehicles is somewhat astonishing the petroleum enthusiasts, and many of the most prominent petroleum carriage users have one, two or three electrically propelled carriages as well. One of the most prominent men in Paris, who has a magnificent chateau some thirty miles from that metropolis, has four electric vehicles always in commission, and has even gone so far as to sell his petroleum carriages, asserting that the electric vehicles are entirely devoid of the many troubles he has had with those driven by petroleum. He has a large ten-seated omnibus, a victoria and a four-seated phæton, besides which he has a wagon, used by his gamekeepers at his shooting boxes, finding that he can save quite a number of guards by being able to send them from one place to another quickly and surely.

The great demand in France to-day is for broughams and victorias driven by men on the box. The average French automobile owner does not care to drive himself through the streets of Paris at the risk of being crushed by malicious omnibus drivers, and with no means of resenting the insulting threats of the ordinary Paris cabby. In other words, electrically propelled broughams for winter and victorias for 9 months of the year are what is being demanded by Parisians to-day. The Electric Vehicle Company has developed just what these people want, and large quantities of running gear are being shipped from the Hartford and Elizabethport factories to both Paris and London. The carriage bodies having been manufactured on the other side are now quite ready to be placed on these gears, and in a very short time the number of Columbia vehicles now running through the streets of both Paris and London will be very materially augmented.

The day of the large petroleum carriage is fast coming to an end. The petroleum voiturette, however, is becoming more and more popular, and small vehicles to hold two or four persons and weighing from 900 to 1200 lbs. are and will continue to be in increasing demand. These little voiturettes are easily handled and are bound to become more popular every year for people living a short way out of town. The speeds vary from that of a walk to 30 miles per hour, and they are so light and easily handled that accidents are more than rare. Besides this, they are very cheap to run, and where petroleum costs 12 cents a quart this item is very appreciable. The petroleum voiturette is now attaining its most simple expression, the parts being reduced to very few in number, and the first complications being rapidly eliminated by a much greater knowledge of the art. In a short time every person in Paris of any means whatever will be the owner of at least an electric brougham, a victoria and a small petroleum voiturette. The number of these three types of carriages now circulating in the larger cities of Europe seem to astonish the traveling American, but I am glad to see that the most rapid progress is coming from the United States. It has been a long time getting there, but from present indications I am quite willing to believe that not only, as is actually the case, will American electric vehicles be far superior to those built in Europe, but American petroleum voiturettes will certainly take the first place, ahead of those built in France.

## Electrical Engine Governor.

The accompanying illustration shows an electrical engine governor for engines driving alternating current machinery, devised by Mr. C. G. Y. King, mechanical engineer of the Chicago Edison Company. The governor is now in successful use on the Porter-Allen engines of 400-kw and 1000-kw capacity, respectively, at the new power plant of the Commonwealth Electric Company of Chicago, and will be applied to two new Allis engines (2500 kilowatts and 3500 kilowatts) at the Harrison Street station of the Chicago Edison Company.

ELECTRICAL ENGINE GOVERNOR.

The device consists essentially of a self-contained motor-driven counterbalance weight. By supplying current to the motor, the weight of which it forms part, is moved along the counterbalance lever, thereby affecting the governing of the engine. By this means engines driving alternating current generators can be synchronized at any requisite distance from the generator, and the switchboard operator is given control of the engine regulation at all times.

# NEWS OF THE WEEK.

## Financial Intelligence.

THE WEEK IN WALL STREET.—The New York stock market experienced much sensational excitement last week, resulting in a semi-panic in certain railway shares and the biggest trading transactions on record, followed by a very sharp rally. Simultaneous with the tumult in New York like scenes were being enacted in London, all of which emphasize the delicate poise of the great markets of the world and their interdependence. The tractions and electrical securities did not participate in the wildness of railway trading; indeed, considerable weakness was betrayed in the general falling off in quotations. Brooklyn Rapid Transit closed with a net loss of 3⅛ points, after an active market of several weeks with soaring prices. The sales were 231,750 shares, the quotations for the week ranging from 81 to 87¾. Metropolitan Street Railway shows a heavier falling off —5¼ points—the range of prices being 165 to 174. General Electric, too, took a downward turn, and on sales of only 3,100 shares closed with a loss of 5 points, the lowest quotation being 185 and the highest 192¾. Western Union keeps at near its normal, showing a net loss of ¼ point at the close. The total number of shares sold at New York during the week was 7,511,415, against 5,028,813 the week previous, and 2,779,967 the same week a year ago. Call money closed at 3 per cent, and sixty-day loans at 4. The market for outside securities was abnormally dull, due to attention being diverted to the sensational character and developments in the stock market. Among the principal gains for the week were Telegraph, Telephone & Cable and Electric Boat pfd., 4 points; among the declines was Electric Vehicle common. There was some trading in General Carriage, but other transportation stocks were neglected. The closing quotations follow:

NEW YORK.

| | Dec. 29. | Jan. 5. | | Dec. 29. | Jan. 5. |
|---|---|---|---|---|---|
| Gen. Electric | 193 | 188 | Elec. Veh. | 19 | 17 |
| Bklyn. Rap. Tran. | 86 | 82⅞ | Elec. Veh., pfd. | 45 | 43 |
| Met. St. Ry. | 171 | 165¾ | Gen. Car. | 4¼ | 3½ |
| Am. Tel. & C. | — | — | Ill. Elec. Veh. Tran. | 1 | 1 |
| West. Un. Tel. | 84 | 83¾ | N. Y. Elec. Veh. Tran. | 6½ | 6¼ |
| Am. Dist. Tel. | 36½ | — | N. E. Elec. Veh. Tran. | 3¼ | 3¼ |
| Com. Cable | — | — | Tel. & Tel. Co. of Am. | 2¼ | 6½ |
| Elec. Boat | 27 | 28½ | Hud. Riv. Tel. | 116 | 116 |
| Elec. Boat, pfd. | 48 | 47 | N. Y. & N. J. Tel. | 173 | 173 |

BOSTON.

| | Dec. 29. | Jan. 5. | | Dec. 29. | Jan. 5. |
|---|---|---|---|---|---|
| New Eng. Tel. | — | 128 | Erie Tel. | 100 | 90 |
| Mex. Tel. | 2¾ | 2½ | Gen. Elec. pfd. | 155 | 156 |
| Westing. Elec. | 56 | *54½ | Am. Tel. & Tel. | 155 | 155⅞ |
| Westing. Elec. pfd. | — | 66 | Ed. Elec. Lt. | — | — |

PHILADELPHIA.

| | Dec. 29. | Jan. 5. | | Dec. 29. | Jan. 5. |
|---|---|---|---|---|---|
| Elec. Stor. Bat. | 88 | 84 | Phil. Elec. | 5⅛ | 5¾ |
| Elec. Stor. Bat., pfd. | 90 | 90 | Pa. Elec. Veh. | 2 | 2 |
| Elec. Co. of Am. | 9¾ | 9⅛ | Pa. Elec. Veh., pfd. | 1 | 1 |
| Gen. Elec. Auto | — | — | Am. Rys. | 33 | 32⅝ |

CHICAGO.

| | Dec. 29. | Jan. 5. | | Dec. 29. | Jan. 5. |
|---|---|---|---|---|---|
| Chicago Edison | 145 | 151½ | Chicago Telep. Co. | 235 | 230 |
| Chic. City Ry. | 253 | 253 | Union Traction | 11¼ | 12½ |
| Nat'l Carbon | 16 | 16 | Union Traction, pfd. | 45¼ | 49 |
| Nat'l Carbon, pfd. | 83½ | 84 | Northwest Elev. Com. | 28½ | 28½ |

*Askeu.

CONTROL OF NORTH AMERICAN.—Statements published last week to the effect that J. P. Morgan & Company had acquired possession of the North American Company, with a view to using its liberal charter in the financing of the anthracite coal deal, are not fully confirmed. The firm has for some time held a considerable interest in the company, and will probably be directly represented on the managing board by the election of Robert Bacon, one of its members, to the North American directory next month. The Morgan interest in the company is not newly acquired, and the use of the company for a joint selling agency in the coal trade has never been seriously discussed. At present the North American confines its activities to the operation of electric light and traction and lighting enterprises in Cincinnati and Milwaukee. The very broad powers conferred by the company's charter, which could probably not be duplicated, have frequently made its possibilities as a finance agency a matter of discussion. The late Mr. Villard had some large ideas in this respect.

MEXICAN TELEGRAPH COMPANY.—The Mexican Telegraph Company, capital $2,000,000, reports gross receipts from 1881 to Dec. 31, 1900, of $6,165,489; net profits, $4,531,303. Dividends paid amount to $3,122,886, leaving a surplus of $1,408,416, of which $531,654 has been invested in the plant, such investment having been capitalized and issued to shareholders in full paid stock, leaving a balance of $876,762, which is represented in first-class securities and cash in bank. The operating expenses, repairs and renewals have averaged less than 27 per cent of the gross receipts. President Scrymser says: "The results of the company's operations, covering a period of twenty years, indicate that the durability of submarine cable property surpasses that of railroads, manufacturing and similar enterprises. Also that its earning capacity, when well located geographically, shows larger receipts, with less cost of operating expenses and repairs than the class of property mentioned."

DETROIT UNITED RAILWAY COMPANY.—Articles of association of the Detroit United Railway Company, capitalized at $12,500,000, have been filed with the Secretary of State of Michigan, together with a franchise fee of $6,000. The new company will take over the franchises and property of the Detroit Electric Street Railway, Detroit, Fort Wayne and Belle Isle Railway, Detroit Citizens' Street Railway, and Detroit Suburban Railway Company. The incorporators are: R. T. Wilson, M. O. Wilson, James M. Edwards, of New York; Jere C. Hutchins and Albert E. Peters, Detroit; Henry A. Everett and Ralph A. Harmon, of Cleveland. Mr. T. J. Johnson retires from the system, selling out completely.

MORTGAGE AT BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has given a first mortgage for $3,500,000 to the Old Colony Trust Company of Boston to cover an issue to that amount of 50-year 5 per cent gold bonds. The bonds are redeemable at any time upon payment of principal and interest. The mortgagor owns and operates all the electric car lines in Birmingham, and forms a consolidation of all other local car interests. Half of the proceeds of the bond issue will be used to pay bondholders of the absorbed companies, and the rest will be turned into the treasury of the company for operating the consolidated system.

CONNECTICUT.—The Connecticut Lighting & Power Company, of Waterbury, has filed in the State Secretary's office a certificate of increase of capital from $1,000,000 to $15,000,000. The announcement is of particular interest, taken in connection with the purchase by this company of the Bridgeport Traction Company, and the recent acquirement of other large electric railroad interests in the State.

CHICAGO.—The Commonwealth Electric Company, which is the consolidation of several suburban properties, effected by the Chicago Edison Company some time ago, has listed $3,000,000 5 per cent bonds on the local exchange.

MUNICIPAL BONDS.—Tampa will issue $250,000 5 per cent 15-year water and light bonds. Waterbury, Conn., will petition the Legislature for permission to bond the city to the amount of $100,000 for the purpose of going into the business of municipal lighting.

DIVIDENDS.—The North Chicago Street Railway has declared a quarterly dividend of 3 per cent, payable Jan. 15.

## Commercial Intelligence.

THE WEEK IN TRADE.—While there is nothing particularly noteworthy in the development of trade last week, the conditions, on the whole, were satisfactory; everything pointing to a period of activity and prosperity. Trade was generally quiet in all lines, interest being concentrated largely in stock-taking and the contemplation of the results of 1900. The ordinary measures of business continue to make gratifying exhibits. Bank exchanges for the leading cities outside New York show an increase of 10.4 per cent over last year and a gain of 18.2 per cent over 1899; while at New York the exceptionally heavy annual interest settlements combined with large speculation to make a gain of 42.2 per cent over 1900 and 38.4 per cent over 1899. The feature in iron and steel was the large sale of steel rails reported from the West, one lot sold in Chicago being for 25,000 tons. Structural material makers are getting good orders, and bridge builders are anticipating a heavy business. Sixty-three railways show an increase of 10.46 per cent in earnings during the third week in December, as compared with the earnings during the same period in 1899. *Bradstreet's* reports the number of failures for the week as 268, against 213 the previous week, and 229 the corresponding week last year. The copper market was very dull, prices being unchanged. Lake is held nominally at 17c., and electrolytic is quoted at 16⅝c.; casting, the same.

ENGLISH COLONIAL TRADE.—British colonies furnished last year a market for over $500,000,000 worth of British goods. The "Statistical Abstract for the Several Colonies and Other Possessions of the United Kingdom," which presents the details of the commerce and conditions of the British colonies in the year 1899, compared with preceding years, has just reached the United States Treasury Bureau of Statistics. It shows that the British colonies throughout the world imported in 1899 goods valued at over a billion dollars, and of this amount over $500,000,000 was from the United Kingdom. England's largest colony, of course, is British India. Its total imports in 1890 are given in round terms at about $300,000,000, of which $200,000,000 were imported from the United Kingdom. Next in importance is Canada, whose total imports amount to $140,000,000, but which takes only $35,000,000 in value from the United Kingdom. The chief reason of this small proportion being her immediate proximity to the United States, which can supply more promptly and conveniently her varied wants. Next in importance is the group of Australasian colonies, whose reports show on the face an importation in round numbers of over $350,000,000 in 1899, though the fact that each colony counts as "an importation" anything coming from any other Australian colony, even though merely brought across the line from adjoining territory makes this statement of Australian "imports" a misleading one. A careful analysis of the real import trade of the Australian colonies shows that their importation from countries outside of the Australian continent amount to about 55 per cent of the sum which they name as "imports." Basing an estimate upon this analysis of the 1898 figures, it may be assumed that the imports of the Australian continent in 1899 were not far from $200,000,000, of which the United Kingdom, although located on the opposite side of the globe, furnished over $130,000,000 in value. The value of the importations of the British West Indies in 1889 was about $33,555,000, of which about $13,610,000 were from the United Kingdom. The African colonies show total imports of $130,000,000 in value, of which $85,000,000 are from the United Kingdom. At the Cape of Good Hope alone the imports for the year are, in round terms, $100,000,000, of which $65,000,000 are from the United Kingdom. In none of these colonies is there any prejudice against American goods, but a warm appreciation of them.

ELECTRICITY IN SIAM.—With regard to recent events at Bangkok, United States Consul-General Hamilton King writes: "The present lighting company has increased its capacity from 10,000 to 17,000 lamps, and has installed at the present time over 10,000 lamps. The second annual report of the directors to the shareholders shows a dividend at the rate of 4 per cent for the half year. Perhaps the most interesting feature just now is the fact that the Bangkok Tramways Company, Limited, and the Siam Electricity Company are being consolidated under the name of the latter. This new company has just secured a concession from the Government to build 5½ miles of street railway line through the most promising portion of the city of Bangkok. Thus it will be seen that the Siam Electricity Company now not only controls the concession for lighting the entire city, but such concessions as have thus far been granted by the Government for building street railways. The capital of this company will be about $500,000 gold. Orders for the supplies have already been placed, and it is expected that the road will be in operation by the end of next year. Before consolidation, the light company furnished power only during the night, but since that time it is advertising electric power for both night and day use. This will probably be taken advantage of by many of the smaller manufacturing interests of the city and may in itself create quite a demand for electric supplies. In connection with this, it may be mentioned that the directors of the company have under contemplation the introduction of electric automobiles, to which they propose to furnish power. Few cities are better adapted to the use of automobiles than is Bangkok. The streets are absolutely level, and the pavement, which now covers many miles, is being rapidly extended in all directions. Besides this company, there are thirteen private electric plants installed in the rice mills of the city; two of the forts have their own plants; five ships of the navy are lighted by electricity; the navy yard is supplied with five or six portable dynamos, and a large installation is owned by the Bangkok Dock Company. Another company is just now endeavoring to get a concession from the Government to build a street railway on the other side of the river.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Jan. 1: Antwerp, 155 packages electrical material, $13,576. Amsterdam—3 cases electrical material, $176. Argentine Republic—158 packages electrical material, $6,389; 32 cases electrical machinery, $2,990. British East Indies—24 cases electrical material, $773; 19 packages electrical machinery, $6,300. Brussels—21 cases electrical machinery, $564; 2 cases electrical material, $205. Bristol—3 cases electrical material, $366. British West Indies—12 cases electrical material, $660. Chili—8 packages electrical material, $259. Central America—322 packages electrical material, $1,161. Cuba—68 cases electrical material, $2,150. Glasgow—11 cases electrical machinery, $444; 27 electrical cables, $11,116; 4 cases electrical material, $64. Genoa—50 packages electrical material, $8,844. Hamburg—4 packages electrical machinery, $2,200; 51 packages electrical material, $1,579. Havre—4 packages electrical material, $503. London—24 packages locomobiles, $7,500. Liverpool—6 packages electrical machinery, $279; 11 packages electrical material, $599. Manchester—4 packages electrical machinery, $2,165; 26 packages motor trucks, $1,200; 136 packages electrical material, $19,898. Milan—20 packages electrical material, $1,274. Mexico—47 packages electrical material, $140; 9,411 packages electrical railroad material, $14,439; 1 crate electrical material, $80; 1 motor carriage, $909. Naples—12 cases electrical material, $1,250. Peru—20 packages electrical material, $417. Rotterdam—1 package electrical material, $40. Southampton—24 cases electrical material, $1,073. St. Petersburg—2 cases electrical material, $106. U. S. Colombia—3 cases electrical material, $49. Venezuela—157 cases electrical material, $1,041.

ELECTRICAL GOODS IN INDIA.—Mr. R. F. Patterson, United States Consul-General at Calcutta, writes: "The Calcutta Tramway Company, Limited, is now preparing to change its lines from horse power to electricity, and the contract for the power station has been given to Merrs. Dick, Kerr & Company, Limited, of London, Eng. Electricity is now beginning to be extensively used in Calcutta for various purposes, such as lighting, fans to take the place of punkhas that were pulled by coolies, for driving machinery, etc., and there is an opening here for the sale of electrical machinery and goods, which our manufacturers should take advantage of. I would advise correspondence with Messrs. Kilburn & Company here, who have an electrical plant and are furnishing electricity and electrical machinery and goods; also, with the following-named firms in Calcutta, who are dealers in such machinery and goods, viz., Osler & Company, Octavius Steel & Company, and the Calcutta General Electrical Company. All machinery is now entered duty free in India, but there is a duty of 5 per cent ad valorem on goods. There is a direct line of steamships between New York and Calcutta, but a cheaper freight on machinery and goods not required for immediate use would be by sailing vessels via the Cape."

BELL TELEPHONE OUTPUT.—The American Telephone instrument statement for the month and year ended Dec. 20 shows:

| | 1900. | 1899. | Changes. |
|---|---|---|---|
| Gross output | 63,196 | 53,194 | Inc. 10,002 |
| Returned | 23,593 | 23,391 | Inc. 202 |
| Net output | 39,603 | 29,803 | Inc. 9,800 |
| Since Dec. 20— | | | |
| Gross output | 639,766 | 661,909 | Dec. 22,143 |
| Returned | 280,703 | 206,654 | Inc. 74,049 |
| Net output | 359,063 | 455,255 | Dec. 96,192 |
| Total outstanding | 1,939,568 | 1,580,505 | Inc. 359,063 |

GERMAN PESSIMISM.—A cable dispatch from Germany says: "A surprise has been furnished by the declaration of the president of the Allgemeine Electricitäts-Gesellschaft, one of the largest electrical plants in Germany. This gentleman has said that the development of electrotechnics has reached a point where further extension cannot be expected, and that it is the duty of the company to look to the solving of new problems which might give new occupation to their workshops. The market interpreted this to mean that no more high dividends on electric shares were to be expected, unless new fields were opened. Accordingly, prices of electrical stocks broke heavily."

COPPER TELEGRAPH WIRE.—It is stated that the telegraph department of the Atchison will shortly begin the work of stringing a copper telegraph wire along its line from Albuquerque, N. M., to Los Angeles, Cal. Later a similar wire will be strung between points on the eastern end of the system. Copper telegraph wire is now in service over some distance along this route, and it is the intention to eventually complete the copper line over the whole distance between Chicago and the Pacific Coast. The Postal Telegraph Company long ago went in for copper circuits and the Western Union Company has lately put up a good deal of copper wire.

COSTA RICA.—Señor Don Mendiola Boza, of San José, has contracted with the municipal government of that city for the installation of an electric light plant. The contractor agrees to purchase in the United States the engines, dynamos, line materials and other necessary accessories, selecting the very best and most improved machinery now used for installations of the kind specified and to secure supplies of the best quality and class.

BRAZIL.—Dr. Olympio de Assis, at Minas-Geraes, Brazil, states that in his town some electric railway lines are to be constructed, and he is desirous that manufacturers of electrical apparatus and other kinds of street railway material send him price lists, catalogues, and any other information they may care to give.

# General News.

## THE TELEPHONE.

NASHVILLE, IND.—A telephone exchange has been installed in this city.

PHILADELPHIA, PA.—The United Telegraph and Telephone Company, of this city, with a capital stock of $10,000 has been incorporated under the laws of Delaware.

FREDERICKTOWN, MO.—The Citizens' Telephone Company, with a capital stock of $5,000, has been incorporated by H. M. Whitener, E. D. Anthony, E. L. Graham and others.

SEDALIA, MO.—The Queen City Telephone Company has offered to place telephones in residences free of charge, though it has declined to make a cut in competition with the Bell Company.

ALBANY, N. Y.—The Bath & Cameron Telephone Company, of Bath, has been incorporated with a capital of $400. Directors: Albert Crandall, A. J. Annabel and A. C. Annabel, North Cameron.

ST. LOUIS, MO.—The Central Union Telephone Company will build two additional copper circuits between Alton and St. Louis during 1901. Three lines between the two cities are now in operation.

OTTAWA, ONT.—The New Westminster & Burrard Telephone Company, of British Columbia, is looking into the question of establishing telephonic communication between Victoria and Nanaimo, B. C.

ALBANY, N. Y.—The Morton Telephone Company of Kendall, Orleans County, has been incorporated; capital, $700. Directors, M. J. Storer, of Kendall; Henry Billings and B. F. Cady, of Hamlin.

CISSNA PARK, ILL.—The Iroquois Telephone Company has built about 80 miles of line since October last year. It has now 64 subscribers and a drop capacity of 100. Mr. George E. Weese is secretary.

CRAWFORDSVILLE, IND.—The Home Telephone Company, of this city, is making arrangements to extend its service eight or ten miles into the country. It has in the corporate limits alone over 700 subscribers.

ALBANY, N. Y.—The Subscribers' Telegraph & Telephone Company, of Watervliet, has been incorporated with a capital of $15,000. Directors: D. S. Johnston and J. E. MacLean, Cohoes; S. J. Cavanaugh, Watervliet.

MORNING SUN, IA.—The Morning Sun telephone exchange anticipates considerable increase in its rural line business. It now has a switchboard capacity of 70 drops and 57 subscribers, of which 45 are of recent acquisition.

METROPOLIS, ILL.—The Cumberland Telephone & Telegraph Company, which has just begun erecting poles for a local exchange, has been enjoined from doing any further work until Jan. 14, when the Court will be asked to decide whether the City Council may grant two telephone franchises.

BOSTON, MASS.—It is learned from officials of the New England Telephone & Telegraph Company that the number of subscribers in the city of Boston proper is now 20,659. The subscribers in the Boston and suburban district number 30,800, constituting this one of the largest exchanges in the world.

KOKOMO, IND.—The Citizens New Independent Telephone Company that recently put in operation their $30,000 telephone plant in this city has met with success far beyond expectations, and is extending its lines rapidly to all the surrounding towns. The superintendent thinks 1,000 instruments will be in use by Jan. 1.

DAWVILLE, IND.—The Dawville Mutual Telephone Company now has 265 subscribers in this city, and its lines reach the homes of 140 farmers in this county. The company has recently added 50 new subscribers to its system, and is looking for a further increase of 25. Mr. O. T. Spencer is secretary and superintendent of the company.

CORYDON, IND.—The negiotiations which have been pending for some time here between Oscar Wright and Louisville, Ky., and Indianapolis parties for a telephone service for Corydon and Harrison county, have been about closed. This service will have long-distance connection through the New Long Distance Company, of Indianapolis.

WATERVLIET, N. Y.—The Subscribers Telegraph and Telephone Company has been incorporated with a capital of $15,000 to operate telephone lines between Watervliet, Troy, Albany, Rensselaer, Colonie, Green Island and Schnectady. The directors are David S. Johnston and John E. MacLean, of Cohoes; William R. Condon, Charles F. Rodgers and Clarence Strevell, of Albany; Thomas J. Cavanaugh, of Watervliet, and Edgar T. Chapman, Jr., of Colonie.

KNOXVILLE, TENN.—Mr. J. C. Duncan, general manager of the People's Telephone and Telegraph Company in this city, states that the reports which have been circulated for the last few weeks that his company had sold out to the Cumberland Telephone Company are untrue. He says that his company has almost the entire exchange business of the city, and has added 300 new subscribers in the last two months.

## ELECTRIC LIGHT AND POWER.

GILMAN, ILL.—Messrs. Parker, Allen & Grenier have been succeeded by the Gilman-Onarga Electric Light and Waterworks.

MARYSVILLE, WASH.—An electric lighting plant will be installed at the new shingle mill of Donoghue, Robinson & Company, in this place.

VINCENNES, IND.—A mortgage amounting to $165,000 has been filed by the City Electric Light Company to the Royal Trust Company, of Chicago.

NEW BRITAIN, CONN.—The style of the Connecticut Lighting & Power Company has been changed to Connecticut Railway & Lighting Company.

CONWAY, ARK.—The city of Conway has purchased the plant of the Conway Electric & Manufacturing Company and it will be operated by the municipality.

OWENSBORO, KY.—A brand-new electric plant is being installed here. Westinghouse, Church, Kerr & Co. are contractors for the new machinery which is in process of installation.

CLEVELAND, OHIO.—Hobdel & Benes, architects, are preparing plans for a 12-story office building for the Citizens Banking Company. The building will be equipped with an electric lighting plant.

ALBANY, N. Y.—The Capital County Light, Heat & Power Company, of Watervliet, has been incorporated; capital, $25,000. Directors: D. S. Johnston and J. E. MacLean, Cohoes; Robert Williams, Watervliet.

ALBANY, N. Y.—The Ossining Heat, Light & Power Company, of Sing Sing, has been incorporated with a capital of $250,000. Directors: J. B. Summerfield and A. L. White, Brooklyn; J. M. Mitchell, New York.

SUMPTER, ORE.—It is reported that an extensive electric plant will be installed at once on the Bonanza mining properties near Sumpter, Ore. Electricity and water power will do the work now performed by steam at those mines.

PINE BLUFF ARK.—The City Council has granted W. H. Keyser, of Chicago, an extension to April 1, 1901, in which to comply with the conditions of the franchise granted him some months ago to build and maintain an electric light plant and street railway system.

CLEVELAND, OHIO.—The Madison Realty Company will build two large apartment houses at an aggregate cost of $375,000. They will be equipped with electric lighting plants and elevators. Teubusch & Hills, Cleveland, are preparing the plans.

HILO, HAWAII.—The Hilo Electric Company, in the Hawaiian Islands, is about to install a 250-kw Westinghouse generator, direct connected to a McIntosh & Seymour engine. The steam plant was purchased through Charles C. Moore & Company, San Francisco.

SAN FRANCISCO, CALIF.—The Independent Electric Light & Power Company's system in San Francisco will be supplemented by a large gas plant. Claus Spreckles has engaged eminent engineers and will install a gas lighting system capable of supplying the entire city.

BEN LOMMOND, CALIF.—The Ben Lommond Light Company has been incorporated with Ben Lommond, Calif., as the place of business. Directors: D. W. Johnston, J. G. Tanner, H. F. Anderson, B. Lloyd and B. Dickinson. Capital stock, $2,000; subscribed, $500.

CRESTON, IA.—The City Council and the electric light company are at war. The city will not renew the old contract unless the lighting company increases the number of lights and not the price, and the company will not do this unless the city gives a long-time franchise, which the city refuses. In consequence the lights are out.

WATERVLIET, N. Y.—The Capitol County Light, Heat and Power Company, which proposes to manufacture gas and electricity for lighting, heat and power purposes, has been incorporated. The capital is $25,000, and the company will operate in Watervliet and in the town of Colonie. The directors are David S. Johnston and John A. MacLean, of Cohoes; Robert Williams, of Watervliet; Edgar T. Chapman, Jr., of Colonie, and William R. Condon, of Albany City.

INDIANAPOLIS, IND.—The Home Heating & Lighting Company, which was recently incorporated, and whose incorporation was noted in a recent issue, will immediately begin laying out its electric light plant for the entire city, both for public and private lighting. In the central part of the city (one mile square) a conduit system will be used; outside of this district the wires will be carried overhead on poles. A substantial power house will be erected of brick, stone and iron.

## THE ELECTRIC RAILWAY.

CIRCLEVILLE, OHIO.—The Scioto Valley Traction Company has made application for a franchise through Circleville.

COLUMBUS, OHIO.—S. B. Hartman, a local capitalist, has applied to the City Council for a franchise for an electric railway in this city.

TOLEDO, OHIO.—The Toledo, Fremont & Norwalk Electric Railway Company has inaugurated a freight service between Fremont and Toledo.

COLUMBUS, OHIO.—The Franklin County Commissioners have granted a franchise to the Columbus, Winchester & Lancaster Electric Railway Company.

COLUMBUS, OHIO.—The Fort Wayne, Dayton & Cincinnati Traction Railway Company has been incorporated with $200,000 capital stock by Dayton people.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company has secured right of way for an extension of its line to Smith's Ferry and Lisbon.

VAN BUREN, OHIO.—The Van Buren Council will grant a franchise to the Findlay Street Railway Company, which is desirous of extending its road through this place to North Baltimore.

CLEVELAND, OHIO.—The Cleveland City Railway Company has leased Scenic Park at the end of its Detroit street line. It will be greatly improved, and will be operated as a place of amusement.

CLEVELAND, OHIO.—The Cleveland office of Babcock & Wilcox Company has closed a contract with Youngstown & Sharon Electric Railway Company for a battery of water tube boilers of 2,000 h.p.

LIMA, OHIO.—The Western Ohio Railway Company, which is building a road to Wapakoneta and St. Mary's, has decided to extend the line from Lima to Findlay. The right of way is being secured.

EAST LIVERPOOL, OHIO.—The Salem, Lisbon & East Liverpool Electric Railway Company will be incorporated within a few days with $500,000 capital stock. Eastern capitalists have financed the project.

COLUMBUS, OHIO.—The Norwalk, Ashland & Southern Railroad Company (electric) has been incorporated by C. P. Wickham, G. T. Thomas, F. C. Jackson, J. R. McKnight and C. C. Curtis. Temporary capital stock, $10,000.

NORFOLK, VA.—Representatives of the St. Louis Car Works have practically closed a deal to acquire certain property here. The idea is to secure a location on tidewater to enable the works to compete on better terms with Eastern car builders.

COLUMBUS, OHIO.—The Mansfield, Mt. Gilead & Columbus Electric Railway Light & Power Company, has been incorporated by T. Y. McCay, P. J. Boals, Thomas E. Barrow, Lewis J. McCay and T. Y. McCay, Jr. Temporary capital stock, $20,000.

CLEVELAND, OHIO.—The Cleveland & Chagrin Falls Electric Railway Company has closed a contract with Sipe & Sigler, Cleveland battery manufacturers, for 220 cells of storage battery, which will be installed in a new station three miles east of Cleveland.

SANDUSKY, OHIO.—The Sandusky, Norwalk & Southern Electric Railway Company has assumed formal control of the properties of the People's Electric Railway Company, and the Sandusky, Milan & Norwalk Railway Company, which were consolidated a short time ago.

NORWALK, OHIO.—William H. Price, a prominent citizen, has brought suit against the sale of the Sandusky, Milan & Norwalk Electric Railway on account of the cancellation of life passes granted to himself and wife by the original company. He asks for $5,000 damages. Mr. Price assisted in building the road.

BRYAN, OHIO.—The Northern Ohio Electric Railway Company has been organized to build an electric road from this place to Defiance. Elias Bartholomew, of Toledo, is president of the company; W. B. Sherwood, vice-president and general manager, and H. C. Warren secretary and treasurer. Franchises have been secured.

CLEVELAND, OHIO.—At the January meeting of the stockholders of the Cleveland City Railway Company, a proposition will be considered to increase the capital stock of the company from $8,000,000 to $9,000,000. The increase is to pay the expense of changing the cable lines to the electric system, and providing new rolling stock and equipment.

NORWALK, OHIO.—President Comstock, of the Toledo, Fremont & Norwalk Electric Railway Company, announces that notwithstanding the fact that two companies are already projecting roads between Norwalk and Oberlin, his company will extend to Oberlin next summer. It is probable that an additional power house will be built at Norwalk.

CLEVELAND, OHIO.—The Western Ohio Railway Company, which is building a road from Lima to St. Mary's, has closed a contract for the erection of its power house at St. Mary's. A contract has been closed with the Cleveland office of the Sterling Boiler Company for a battery of boilers of 1,500 h.p. Contracts for engines and generators have not yet been closed.

SPRINGFIELD, MASS.—Local capitalists are working out a project for the construction of an electric street railway line between Palmer and Springfield—a distance of 15 miles. The line will connect with the new road from Monson to Palmer; it will give a direct line from Springfield to all the important towns in the eastern part of Hampden County, and it will fill one of the two existing gaps in the continuous line of street railway from Boston to Springfield. The promoters of the enterprise have not, as yet, organized a corporation, but will do so soon. The flotation of the entire proposed capital stock is already assured.

STEUBENVILLE, OHIO.—At a meeting of the stockholders of the Steubenville, Mingo & Ohio Valley Traction Company, the following officers were re-elected: William Hearne, president; William Lipphart, vice-president; L. S. Sands, treasurer; F. H. Eicke, treasurer. The above, with H. E. Sands, L. G. Hallock, J. H. McKee, constitute the board of directors. The road is to be extended to Brilliant, and a new park is to be constructed at Altamont. It is also proposed to organize an independent company, with $350,000 capital stock, to furnish power, heat and light in Steubenville and surrounding towns. For this purpose extensive additions are to be made in the Steubenville power house.

CLEVELAND, OHIO.—Mayor John Farley has presented his proposed 25-year franchise extension for the Cleveland City Railway Company to the Chamber of Commerce for consideration. If reported on favorably it will be presented to the Council. The following are its leading provisions: Universal transfers; six fares for a quarter for twelve years; seven for a quarter thereafter; option to the city of making free territory in downtown streets; a percentage of gross receipts starting at 2 per cent. and gradually raising to 5 per cent.; the company to pave sixteen feet of roadway; to pay half the cost of abolishing grade crossings on its lines; sprinkle its tracks and to accept the city's right to regulate its operation, including that of package and express transportation.

## THE AUTOMOBILE.

AUTOMOBILE FIRE ENGINE.—The Pittsburg Fire Department has just received an automobile fire engine which cost $9200. It will be able to throw 1350 gallons of water per minute.

RICHMOND, IND.—I. H. Sedgwick, of this city, has been at work for a year or more on an automobile constructed on an entirely new principle. His device is perfected and its practicability, it is said, is admitted. He will interest local capital in his invention.

AUTOMOBILES FOR DRUMMERS.—Parkhurst, Davis & Co., a wholesale grocery firm, of Topeka, Kan., will buy automobiles for the use of the half dozen salesmen who travel in Oklahoma, Western Kansas and Nebraska. The automobiles will be used where roads are good and trains few.

THE THOMPSON AUTOMOBILE COMPANY has filed articles of incorporation with the County Clerk at Newark, N. J. The capitalization is placed at $250,000. The principal office of the company will be in Newark, J. C. Bleveney of Newark, J. S. W. Thompson of Morristown, and C. F. McGuire of Newark are named as incorporators.

THE INDIANA AUTOMOBILE CLUB has been organized in Indianapolis. The purpose is to enlist in its membership all the automobile and motor cycle owners and riders in the State for both social and business purposes. G. G. Fisher is president and Lewis Bently secretary. The club will ask the Legislature to enact a law to make the establishing of sign-boards compulsory.

## LEGAL.

NEW YORK FRANCHISES.—Justice Bischoff, of the New York Supreme Court, has handed down a decision which, if sustained by the Court of Appeals, means that Metropolitan will have no right to run cars on Lexington avenue, from Forty-second street to the Harlem River, nor operate the 116th street crosstown line. The decision practically advises all property owners along the lines designated to sue for damages. The company immediately gave notice of an appeal, and was given thirty days' stay of the permanent injunction which had been granted by Justice Bischoff. House, Grossman & Vorhaus, counsel for the man who started the action, say the decision means that actions to recover millions of dollars for damages will be started. The action was brought by Louis Tekulsky, who objected to the maintenance of a transfer station in front of his property. James T. Little, of counsel for Metropolitan, says: "The Tekulsky suit is one of the few remaining 'strike' actions brought against the company two or three years ago. Under Justice Bischoff's decision we think that only the 116th street line would be affected."

## OBITUARY.

MR. EVERETT FRAZAR, senior member of the firm of Frazar & Co., died at Orange, N. J., last week. He was at the time of his death Consul-General for the kingdom of Korea in the United States. He was born at Duxbury, Mass., Oct. 4, 1834. In 1858 he went to Shanghai, China, and established the mercantile firm of Frazar & Co., which has been interested of late in the introduction of electric lighting into Japan and China, one of their contracts being the lighting of the Mikado's new palace in Tokio, Japan, installing there 3,000 electric lights. From 1872 to the present time Mr. Frazar has been the resident partner in New York of Frazar & Co., his home being in Orange, where he was president of the Orange Music Hall Association, which position he held for about five years. Mr. Frazer held the following offices: President of the American Asiatic Association; director of the New Jersey Postal Telegraph Company; director of the Atlantic Mutual Insurance Company, and the Harvey Steel Company, and president of the Sims-Dudley Defense Company. He leaves a widow, two daughters and a son.

MR. T. C. SMITH died last week in his eighty-sixth year at Greenpoint, L. I. He was born in Bridgehampton, L. I. He came to New York and was apprenticed to a builder, and a few years later, after establishing a business of his own, he became Superintendent of Buildings. At the time of the Civil War he came into possession of a small porcelain factory in Greenpoint. He went to Europe, where he spent two years about the large porcelain works, and on his return he established the Union Porcelain Works, which now occupy a square block in Oakland street, Greenpoint, and whose product has long been familiar to electrical concerns. He was one of the organizers of the Seventeenth Ward Bank, and for four years was its president. For twenty-five years he was president of the Ophthalmic Hospital in New York. He was a trustee of the Greenpoint Savings Bank and of the Mechanics' & Traders' Society of New York, and he was a life members of the New York Historical Society and the Havens Relief Fund Society. He helped to organize the Manufacturers' Insurance Company. Under Mayor Low's administration, Mr. Smith was a Brooklyn Park Commissioner. He is survived by a widow, one son and three daughters.

## PERSONAL.

MR. W. J. CLARK, European manager for the General Electric Co., is expected in this country.

MR. E. A. CAROLAN, of the General Electric Company, has returned from his extended business trip throughout the Far East.

MR. GEORGE WESTINGHOUSE has bought the old Ely-Copperfield mines in Vermont, and will develop them, an abundance of copper still being there, it is said.

MR. GEORGE A. MAYO, a veteran electrical engineer, etc., has just reported from Seattle, Wash. He has been up in Alaska securing some very valuable gold claims, etc., and is going back this year.

MR. HIRAM S. MAXIM, the well-known American inventor in the electrical field, etc., and long domiciled in England has just been knighted by the Queen. He is largely interested in English works for making his machine gun, etc.

MR. L. M. HANCOCK, of Colgate, Yuba County, has lately been appointed general superintendent of the Bay Counties Power Company, of California, and is busily occupied with the notable transmission enterprise of that corporation.

MR. ALEX. WYNESS, JR., has been elected secretary of the Geneseo Gaslight Company, of Geneseo, N. Y. Mr. Wyness is now secretary and superintendent of the works, and his election as secretary is a recogntion of the services which he has rendered the company.

MR. H. F. PARSHALL, the American electrical engineer who has been so actively engaged in electric railway work in England, has arrived here on a short visit. He reports very favorably on the technical and commercial success of the underground London Central Railway, of which he has been the consulting engineer since its inception.

MR. PHILIP DAWSON, chief engineer, director, etc., of Robert W. Blackwell Co., of London, is now in this country to spend a month on various business errands. He speaks hopefully but conservatively as to electric railway development in England and on the Continent. While in New York he is staying at the Albemarle Hotel.

MR. I. L. RICE.—It was announced in Wall Street this week that Isaac L. Rice, president of the Consolidated Railway, Electric Light & Equipment Company, who has been in Europe for five months, has finally completed his contract with Vicker, Sons & Maxim. From a cablegram received, the contract is in every way satisfactory, and Mr. Rice is preparing to sail for America.

MR. J. W. MARSH, vice-president and general manager of the Standard Underground Cable Company, Pittsburg, Pa., on Jan. 3 made an address before the Pittsburg Chamber of Commerce on the submarine cable business in the United States, in which he said that American manufacturers were perfectly able to take care of the work in laying the Pacific cable to Hawaii, the Philippine Islands and Japan. The address was attentively and enthusiastically received by the members of the chamber, and at the conclusion a vote of thanks to Mr. Marsh was passed.

MR. ROGER W. CONANT, who was connected with the Boston Elevated Railway for nine years as electrical engineer, has resigned to accept a position with the Gold Car Heating Company as manager of their New York office. Mr. Conant is well and favorably known to railway officials both here and abroad through his writings on subjects pertaining to electrical and mechanical engineering. He is a graduate of the Massachusetts Institute of Technology and has been engaged in practical railway engineering for many years. His resignation from the Boston Elevated Railway was received with regret, the management expressing their appreciation of his work and heartily wishing him success in his new undertaking.

## EDUCATIONAL.

VIRGINIA MILITARY INSTITUTE.—The new plant just installed in the Virginia Military Institute at Lexington, Va., is to be used entirely for experimental work in the Department of Physics. It includes one 7-kw Wagner rotary converter driven by a 10-hp Otto gas engine, and a storage battery of 15 cells.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—The students of the senior class taking steam engineering at the Massachusetts Institute of Technology are now in the midst of one of two boiler tests which are carried on as a part of the work in the engineering laboratory. The first one is to last 96 hours and the second 88 hours. The students are divided into watches of four, each watch serving for eight hours. The boilers on which the first test is being made are 100 horse-power each, are 16 ft. long, 60 ins. in diameter and have 84 3-in. tubes which are cleaned every 24 hours. Two of the four boilers have Hawley down-draught furnaces and two have Sheffield shaking grates. Every 12 hours, and at the end of the 96 or 88 hours, the four are cleaned, the ash-pit cleared and the water brought to the position of the start; then the data are collected and recorded upon blanks by every student, and the students from these calculate the results of the test. The three watches of the day begin at midnight, at 8 in the morning and at 4 in the afternoon. The chemical analysis of the coal is found, and the heat of combustion of it in B. T. U. The total evaporation from and at 212 degs. F. per pound of dry coal, per pound of combustible, and per square foot of heating surface per hour. The coal burned per square foot of grate surface per hour is found. The boilers are rated in horse-power developed according to the American Society of Mechanical Engineers' standard. This test is the end of the first term's work of the Engineering Laboratory.

## Trade Notes.

THE SKENE AUTOMOBILE COMPANY, of Lewiston, Me., has been succeeded by the Skene American Automobile Company.

THE U. S. ELECTRIC CONSTRUCTION COMPANY has succeeded to the business of Cronin David, Syracuse, N. Y., dealer in electrical supplies.

THE STANDARD ELECTRIC COMPANY, Cincinnati, Ohio, has moved to a new location at 113 West Third Street, now occupying the entire six-story building.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, Philadelphia, Pa., has issued its monthly calendar blotter for January. The company is sending it to the trade, accompanied by circulars descriptive of an electric pressing iron.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, Mass., announces that it has increased its storage capacity for its electric light business and will carry a largely increased stock. It will thus be enabled to fill orders with promptness.

ACCUMULATORS FOR ISOLATED PLANTS.—The storage battery plant at the residence of Mr. Archibald Rogers, Hyde Park, N. Y., is described and illustrated in the Electric Storage Battery Company's circular No. 63. This is a model and interesting plant.

THE LUNKENHEIMER COMPANY, of Cincinnati, is distributing a daily calendar with figures 4 ins. high. Although it is not what one would call an attractive calendar, it cannot be hung in an office without attracting attention, and it will keep Lunkenheimer's valves, whistles, oil cups, etc., constantly in mind, particularly the whistles.

STEAMSHIP FORCED DRAFT.—The boilers of the new eighteen-knot Ward Line steamship "Morro Castle," having 442 sq. ft. of grate surface, are equipped for forced draft furnished by four special Sturtevant fans having wheels 66 ins. in diameter, driven by direct connected double enclosed engines designed to run at 480 revolutions per minute.

I-T-E CIRCUIT BREAKERS.—The Cutter Company, Nineteenth and Hamilton Streets, Philadelphia, Pa., in a circular, makes an important trade announcement with reference to its I-T-E circuit breakers. Those interested in these instruments will do well to send for a copy of the circular, from which they will learn something of advantage to themselves.

WALSH'S SONS COMPANY, Newark, N. J., who are dealers in scrap iron metals and second-hand machinery, including motors, engines, boilers, etc., have issued for 1901 a desk calendar and dairy pad combined, each leaf containing the dates for one week. The back of the calendar is taken up with calendars for 1901 and 1902. The whole presents a very neat appearance and is more than ordinarily useful.

HOUSEHOLD AND EXPERIMENTAL SUPPLIES AND NOVELTIES.—Messrs. J. Elliott Shaw & Co., 632 Arch Street, Philadelphia, Pa., have just issued catalogue and price list No. 9 of household and experimental supplies and novelties. The contents cover a broader ground than the title indicates. Almost everything in the electrical line is handled by this firm. The catalogue contains 234 pages and is provided with a very complete index.

THE CARLISLE & FINCH COMPANY, Cincinnati, reports business exceedingly good, particularly in electrical novelties. The demand for its sparker dynamos for gas engine ignition is very heavy and the company has orders ahead for several weeks. This company has just filled a number of important searchlight contracts, some for the United States Navy and some for the United States Army.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, has closed a contract with the Manix Dry Goods Company at Nashville for a complete lighting plant consisting of two 11 x 14 Buckeye engines direct connected to two 62½-kw generators, together with complete marble switchboard and other appliances. The same company has just installed a complete lighting and power plant for the Eureka Foundry Company in Cincinnati.

THE STEPHENSON MANUFACTURING COMPANY, of Albany, N. Y., reports a steadily increased business on its bar belt dressing, not only among belt users throughout this country, but abroad. The foreign orders are coming to it as a direct result of free samples sent to various countries upon request of the recipients, who, after testing the sample, order without hesitation. These samples are sent by mail to all who will take the trouble to write for them.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, Cleveland, Ohio, is just completing an exchange of 400-drop capacity for the Salamanca Telephone & Telegraph Company, Salamanca, N. Y. An exchange of 1000-drop capacity is nearly completed at Hornellsville, N. Y., and work has just been started on a 1000-line exchange for the Corning Telephone Company, Corning, N. Y. The company is also furnishing considerable equipment to the Chagrin Falls Telephone Company, Chagrin Falls, Ohio, which is rebuilding its system.

CALENDARS.—The New England Electrical Works, Lisbon, N. H., have issued a calendar for 1901, the prominent feature being the trade mark of the company, which, being printed in red ink on a yellow background, makes a very attractive appearance. The company notes that it is manufacturing fine magnet wire. The Chase-Shawmut Company has issued a neat monthly calendar for the first year of the new century. The card upon which the calendar is mounted contains a half tone view of the switchboard of the Edison Electric Illuminating Company, Savannah, Ga.

THE NORTHERN ENGINEERING WORKS, Detroit, Mich., report a steadily increasing business in cranes. Their shop has been well filled during the entire year. Much of their product has gone abroad, but the bulk of it has been placed in the best American shops. They manufacture a variety of styles of electric traveling cranes, as well as hand-power, pneumatic and other types. The company has installed considerable new machinery during the past year and contemplates adding more new equipment. A new structural shop for making their own girders was added during the year.

"ABOUT A GOOD PRINT SHOP" is the title of a striking pamphlet, vertical oblong, 7 ins. x 14 ins., issued by Griffith, Axtell & Cady Co., catalogue makers and embossers of Holyoke, Mass. It advertises excellently the ability of the concern in embossing, color printing and all the arts of design; each page, printed on one side only, being an illustration of some branch of their work. The cover is quite noteworthy, bearing the slim figure of a youthful herald embossed in gray, green and gold. The back cover is the same, with the color scheme reversed. The whole is tied with gold thread and wrapped loosely in oil paper.

GOOD FEELING BETWEEN EMPLOYER AND EMPLOYEES.—The Vallee Bros. Electrical Company, Philadelphia, Pa., entertained its employees at a banquet on the evening of Jan. 2 as a mark of its appreciation of the successful results of the past year, obtained largely through the fidelity of its employees. The affair proved to be most enjoyable, both to the members of the firm and employees. At the conclusion of the supper speeches were made by a number of the employees, voicing the good feeling existing between thmselves and the firm, and suggestions were made that will no doubt accrue to the benefit of the firm and its customers. There were 22 persons present, including all the members of the firm.

THE KENTUCKY INCANDESCENT LAMP is the subject of a circular being sent out by the Kentucky Electrical Company, Owensboro, Ky. These lamps are said to be the only ones manufactured in the South, and are guaranteed to maintain candle-power and efficiency and give a satisfactory life if burned at rated voltage on a steady current. They are also guaranteed to be non-blackening. The company's railway lamp has a special filament, consuming 4 watts per candle, and, it is stated, is in every way adapted to meet the severe conditions imposed by railway service. The Kentucky Company also manufactures slow and medium speed dynamos and motors, both of the open multipolar type and the semi-enclosed multipolar type.

IDEAL ENGINES.—Messrs. A. L. Ide & Sons, Springfield, Ill., send us a list of recent sales of Ideal engines for electric work. The aggregate number of engines in this list is 57. Among the machines are the following: One 300-hp, belted type, for the Northwestern Fixture Co., Klondike; one 175-hp direct connected, and one 100-hp direct connected for the Urbana Light, Heat & Power Company, Urbana, Ill.; one 125-hp belted engine for the electric light company Albuquerque, N. M.; two engines for Daniel Adamson & Co., Dunkinfield, Eng.; one 250-hp belted engine for the City Gas & Electric Company, City of Mexico; one 150-hp direct connected engine for the Lake City Electric Company, Lake City, Ia., and one 250-hp direct connected engine for the Lincoln Gac & Electric Company, Lincoln, Neb.

ELECTRIC MINE LOCOMOTIVES.—The subject of electric mine locomotives is handled in a very interesting and attractive manner in a handsome catalogue recently issued by the power and mining department of the General Electric Company. The catalogue, which contains 46 pages, is very handsomely illustrated with views of various types of mine locomotives and of actual installations. The first section is devoted to a description of the advantages of mine haulage; in the second section is given a detailed description of the General

Electric Company's standard locomotive and includes illustrations of the various types of machines, together with the various component parts, and tables of dimensions and other engineering data. The cost of mine haulage by electric locomotives is also discussed and figures given. At the back of the catalogue is given a list of General Electric mine locomotives in actual use. This list shows that there were, at the time of its compilation, 177 electric locomotives in use. The cover of the catalogue is a very artistic production and the printing and all the mechanical work is of the company's usual high class.

# Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JAN. 1, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

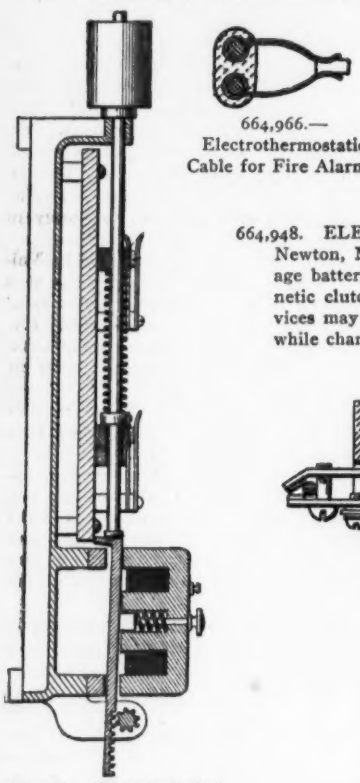
664,865. BURGLAR ALARM; J. H. Howard, Kansas City, Mo. App. filed Oct. 5, 1899. A door mat containing parallel metal disks normally separated, but adapted to make contact to close an alarm circuit when pressure is put upon them.

664,904. MICROPHONE; August Herman Skold, of Stockholm, Sweden. App. filed Dec. 22, 1897. A diaphragm has a number of contact plates on one face, by means of which a corresponding number of granular carbon contacts may be thrown in series, thereby increasing the intensity of the current fluctuations.

664,907. ELECTRIC ELEVATOR CONTROLLER; B. S. Stephens, New York, N. Y. App. filed March 17, 1899. Separate hand ropes are used to open and close the circuit, and one of them is connected to the belt shifter.

664,915. ELECTRICAL DEVICE FOR DETERMINING THE RESISTANCE OR CONDUCTIVITY OF BODIES; H. E. Warren, Newton, Mass. App. filed Jan. 27, 1896. A Wheatstone bridge comprising an arm having variable resistances, whose values are arranged in geometrical proportion having a ratio of 10, an arm formed by the resistance to be measured, a slide-wire forming the other two arms, arranged in a circular path, a movable contact arranged to engage said wire to balance said bridge, a pointer controlled by said contact, a scale so graduated that said pointer when said bridge is balanced, shall indicate on said scale a decimal part of the unknown resistance, a telephone in circuit with said bridge, and a current-detector device in said telephone circuit.

664,939. OUTLET BOX; J. Fountain, Jr., Elizabeth, N. J. App. filed Oct. 27, 1900. The holes of the box providing for the entrance of pipes and conductors are normally closed by disks which can be easily broken out.



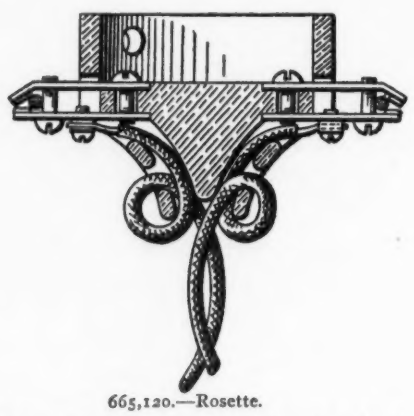
664,986.—Electric Switch.



664,966.—Electrothermostatic Cable for Fire Alarms.

664,941. TELEPHONE ATTACHMENT; G. W. Ganow, Phillipsburg, Pa. App. filed July 2, 1900. The receiver is attached to a holder and normally held directly in front of the transmitter so that it must be pushed aside to use the telephone; this movement changes the circuits.

664,948. ELECTRIC METER; Caryl D. Haskins, of Newton, Mass. App. filed July 29, 1899. A storage battery watt-hour meter provided with a magnetic clutch whereby either of two registering devices may be cut in or out, one device registering while charging and the other while discharging.



665,120.—Rosette.

664,953. ELECTRICAL RESISTANCE BOARD; W. R. King, Newark, N. J. App. filed July 21, 1900. The segments on the face of the board are each provided with two sockets in which to secure the ends of a resistance coil.

664,966. ELECTROTHERMOSTATIC CABLE FOR FIRE ALARMS; A. Munker, Schoeneberg, Germany. App. filed April 14, 1900. At intervals in the cable the two wires composing it are provided with springs which are normally held apart by a fusible block.

664,971. INCANDESCENT LAMP; Edward Riordan, of New York, N. Y. App. filed April 5, 1900. The filament is connected at its middle point to a conductor, which latter is connected to a contact point in the base. By means of a suitable key socket one or both sections of the filament may be kept in circuit.

664,986. ELECTRIC SWITCH; G. H. Whittingham, Baltimore, Md. App. filed March 19, 1900. An electro-magnet serves to connect a power device with the movable part of the switch and to retain said movable part in any position to which it may have been moved by the power.

664,002. TROLLEY FOR ELECTRIC RAILWAYS; L. D. Chabut, Pittsburg, Pa. App. filed June 14, 1900. Details whereby the trolley wheel is confined to the wire until it is released by the hand rope.

665,027. PRINTING TELEGRAPH; H. Mahnken, New York, N. Y. App. filed March 6, 1900. Details.

665,040. AUTOMATIC FIRE ALARM; A. R. Thompson, Indianapolis, Ind. App. filed Sept. 22, 1899. A pair of spring arms are mounted between two terminals and held out of contact therewith by a fusible link.

665,051. ELECTRIC TRACTION; S. G. Bennett, Wolverhampton, Eng. App. filed Oct. 13, 1900. The plough passes between hinged contact pieces which are forced toward each other by springs.

665,065. FUSE HOLDERS; W. R. Cook, Pittsburg, Pa. App. filed April 18, 1900. A cylinder carrying a plurality of fuse wires is rotated after the destruction of each fuse by a device which engages with the fuse itself.

665,087. CONTROLLER FOR ELECTRIC MOTORS; F. W. Garrett, Johnstown, Pa. App. filed Sept. 25, 1900. (See Current News and Notes.)

665,094. MEANS FOR ELECTRICAL CAR PROPULSION; J. H. Hertner, Cleveland, Ohio. An alternating current motor is used for propulsion, while a continuous current generator is driven by said motor to furnish current for operating several magnetic clutches for varying the speed.

665,120. ROSETTE; A. A. Moffitt, Pawtucket, R. I. App. filed Oct. 16, 1900. The rosette contains a number of openings through which the flexible conductor is threaded to remove the weight from the binding screws.

665,127. CONTROLLER FOR ELECTRIC MOTORS; G. H. Parmalee, Johnstown, Pa. App. filed July 25, 1900. (See Current News and Notes.)

665,134. TELEGRAPH OR TELEPHONE CALL MECHANISM; E. E. Salisbury, Chicago, Ill. App. filed March 21, 1900. Details.

665,139. CONTROL OF ELECTRIC MOTORS; B. C. Shipman, Johnstown, Pa. App. filed May 29, 1900. (See Current News and Notes.)

665,143. CONTROL OF ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed June 5, 1900. (See Current News and Notes.)

665,144. CONTROLLER FOR ELECTRIC MOTORS; E. W. Stull, Johnstown, Pa. App. filed June 16, 1900. (See Current News and Notes.)

665,156. DOUBLE POLE SWITCH; R. E. Wood, Baltimore, Md. App. filed Aug. 28, 1900. A modification of the snap switch.

665,195. STORAGE BATTERY; A. G. Eneas, Boston, Mass. App. filed Oct. 9, 1897. An electrode comprising a conducting core, a number of independent rigid porous partitions movable thereon, and active material interposed between the partitions.

665,248. SYSTEM OF ELECTRIC TRACTION; L. M. Maxham, Boston, Mass. App. filed April 28, 1900. One end of a plug is immersed in mercury to which the current leads and the plug is raised by a magnet on the car to close the circuit to the working conductor.

665,251. MOUTHPIECE FOR TELEPHONE TRANSMITTERS; W. S. Moore, Indianapolis, Ind. App. filed May 21, 1900. The mouthpiece is constructed to inclose the mouth and nostrils of the speaker, and connects by means of a tube with the transmitter, the object being to prevent other persons from hearing the conversation.

665,324. MEANS FOR CONTROLLING ELECTRIC MOTORS; J. Green and G. C. Thom, Johnstown, Pa. App. filed June 15, 1900. Two electric motors having independent field and armature connections and designed to operate different mechanisms are combined with a switch for connecting either motor to a single controller at will.

665,362. DRIVING MECHANISM FOR DYNAMOS; W. L. Bliss, New York, N. Y. App. filed April 2, 1900. Details.

665,369. TROLLEY; H. Lachenmeyer, Dusseldorf, Germany. App. filed Feb. 20, 1900. The wheel is inclosed on each side by a cruciform guard mounted independently of the wheel and adapted to retain the wire in the wheel.

665,305. ELECTRICAL TRANSFORMER; Arthur Francis Berry, of London, Eng. App. filed July 23, 1900. The core is composed of built-up laminated iron plates arranged radially, and each having a large hole therethrough. Through the holes extend a coil composed of two concentrically arranged sets of separately insulated conductors; the inner set being arranged in annular rows around a centre one, and the conductors in the outer set being annularly arranged around the inner ones. The inner conductors form the primary and the outer ones the secondary, junction pieces coupling up the lengths of conductors to form the required primary and secondary windings.

665,318. ELECTRIC MOTOR CONTROLLER; F. W. Garrett, Johnstown, Pa. App. filed Aug. 24, 1899. (See Current News and Notes.)

665,319. ALARM DEVICE FOR ARMATURE SHAFTS; F. W. Garrett, Johnstown, Pa. App. filed Sept. 16, 1899. (See Current News and Notes.)

665,320. CONTROLLER FOR ELECTRIC MOTORS; F. W. Garrett, Johnstown, Pa. App. filed March 26, 1900. (See Current News and Notes.)

665,321. METHOD OF CONTROLLING ELECTRIC MOTORS; F. W. Garrett, Johnstown, Pa. App. filed March 26, 1900. (See Current News and Notes.)

665,322. SAFETY DEVICE FOR ELECTRIC MOTOR CONTROLLERS; F. W. Garrett and G. H. Parmalee, Johnstown, Pa. App. filed June 16, 1900. (See Current News and Notes.)

665,337. ELECTRIC RAILWAY MOTOR; F. A. Merrick, Johnstown, Pa. App. filed Dec. 30, 1899. (See Current News and Notes.)

665,350. ELECTRIC MOTOR CONTROL; B. C. Shipman, Johnstown, Pa. App. filed Aug. 5, 1899. (See Current News and Notes.)

665,352. ELECTRIC FUSE BOX; E. W. Stull, Johnstown, Pa. App. filed March 21, 1900. (See Current News and Notes.)